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NOTES

AS stated in the last year's report, the partition of 1947 and the integration of Part B and C States in the Indian Union have necessitated a reorientation both of the administrative machinery and legislative policy of the Government of India concerning its ancient monuments. The Department has now to spread its organization over 11·2 lakh square miles instead of 7·3 lakh square miles in undivided India. It has planned to do so by realigning the boundaries of the existing seven circles and, consistently with economy, adding to them only two major circles as an experimental measure without pressing, at this stage, for two minor circles also. The new circles mainly comprise the integrated Part B and C States and altogether there is an addition of some 520 monuments of national importance, which had hitherto been looked after by the States concerned, to the list of monuments already declared protected and maintained by the Central Government. In the Seventh Schedule of the Constitution Act of India, which deals with the legislative powers of the Union Government and of the States, archaeology has been partly decentralized as explained in *Ancient India*, no. 6, page 1.

In fulfilment of the statutory obligation thus imposed on the Government of India, Parliament passed in November, 1951, 'The Ancient and Historical Monuments and Archaeological Sites and Remains (Declaration of National Importance) Act', by which the monuments and sites previously protected in what are now known as Part A States under the Ancient Monuments Preservation Act of 1904 were re-declared to be of national importance and, what is more important, a large number of monuments and sites in Part B States, being of national importance, have now become the responsibility of the Central Government. For the purpose of the above act the selection of monuments of national importance has, however, been made with the help of the States concerned. Monuments in Part C States, which are centrally administered, *ipso facto* remain the responsibility of the Centre. It remains to be seen, however, to what extent the State Governments evince real interest in monuments, sites and remains which are now in their charge. So far as the maintenance of monuments of national importance in Part B States is concerned, the Central Government, pending the setting up of its own machinery, is utilizing the agency of the State Governments which will be reimbursed by it for all expenditure incurred on them as from the 1st April, 1950. It is to be hoped, however, that this agency system will be terminated as soon as possible.

* * * * * * *

Explorations in Bikaner were resumed and upto the end of 1951 some 150 ancient mounds were plotted in the dried-up river-beds of the Sarasvatī and Drishadvatī. About twenty of these sites are of characteristic Harappā culture, the existence of which finally establishes the eastward spread into the Indian Union of that culture which had been

surmised previously by the discoveries made by me at Koṭlā Nihang near Rūpar in Ambāla District of Panjab. Harappā sites extending into the Dṛishadvatī valley may be taken, more appropriately, to be an eastern variety of this culture. Another score of sites with a characteristic grey ware, akin to what has been found at a number of sites such as Hastināpura, Ahichchhatrā, Bāghpat, Tilpat, Pānipat, Mathurā etc., is helpful in narrowing down the interval of time between the early historic and the Harappā cultures which still remains a Dark Period of Indian History.

* * * * * * *

The further sequence of cultures is clearly revealed by the excavations carried out at Hastināpura, where the dig of 1951 has unravelled five main periods of occupation. The lowest one yielded a dull red ware with poor ochre wash, which seems to have its analogues in the pottery discovered at the Gangetic copper hoard sites of Bisaulī, Rājpur Parsu etc., though this point requires further investigation. It was succeeded by the painted grey ware etc., associated with copper arrow-heads. The occurrence of a great flood, represented at the site by an extensive erosion of the mound, seems to have ended this phase. The occupation was again started in about 600 B.C. by the 'N.B.P.'-using people who also used kiln-burnt bricks and ring-wells for soakage and had square punch-marked currency pieces of beaten silver or copper. This occupation seems to have suffered devastation by a great fire. But the site was again inhabited during the Śuṅga and Kushan periods, indicated by countless terracotta objects of the former and a few coins and a Bodhisattva image of the latter. The last period of habitation came after a great lapse of time during the eleventh century and continued for some hundred years. This culture was characterized by pre-Mughul glazed pottery with a coin of Balban (A.D. 1266-87) dating the phase.

* * * * * * *

Every effort is being made to bridge, or at any rate narrow down, the gulf of time in the Dark Period referred to, and to this end operations are being extended over northern India and the peninsula to corroborate or modify the sequence of the early cultures of India.

M. S. VATS

PORKALAM 1948 : EXCAVATION OF A MEGALITHIC URN-BURIAL

By B. K. Thapar

The south-western coastal strip of India is well-known for its large variety of megalithic burial-monuments, but their chronological and cultural relations with one another and with similar monuments elsewhere in south India can be established only by a series of excavations in typical examples. The present article describes the result of an excavation, conducted by the author in 1948, *in one such example, viz. an urn-burial surrounded by a laterite circle and covered by a granite capstone. The family likeness of the ceramic types and fabric noticed here and at Brahmagiri and other megalithic sites no doubt indicates an alliedness of the different groups comprising the southern megalithic complex, though the different shapes of the monuments and the variations in the burial-customs represented therein seem to preclude an absolute homogeneity.*

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1. INTRODUCTORY

PORKALAM, literally meaning a battle-field,[1] lies two and a half miles to the north of Kunnamkulam in the Talapalli taluk of Trichur District, Travancore-Cochin State. The site, only 50 ft. above sea-level, lies on the low sloping laterite-formation which passes by imperceptible gradation into sandy clay or gravel. Until recently, the site had been extensively despoiled for building material ; it had long served as an easy quarry for the local roads. The Vedakad temple, the most sacred place of worship of the local priestly class, the Nambudris, is built on the site itself. This spoliation has robbed the monuments of many essential features and appendages with the result that no coherent plan of the site with all the type-monuments is feasible.

Consequent upon the discovery of the site, Shri P. Anujan Achan, the State Archaeologist to the Cochin Government, conducted some excavation which was more in the nature of a 'summary digging'[2] primarily intended to collect finds. Nevertheless,

[1]This site marked the boundary of the territories of the Rājā of Cochin and the Zamorin of Calicut and as such featured prominently as a battle-field in their quarrels. (Information from Shri P. Anujan Achan.)

[2]*An. Rep. Arch. Deptt., Cochin State* for the year 1123 M.E. (A.D. 1947-48) (Ernakulam, 1949), Appendix C, p. 14.

the excavation revealed, though superficially, the potentialities of the site. In 1946, Shri V. D. Krishnaswami, at that time the Prehistorian of the Department of Archaeology, carried out an intensive survey of the megaliths of the Cochin State,[1] and his pioneer work had the merit of bringing order out of chaos. As an obvious sequel to this survey was an excavation, I was deputed, in the early part of the year 1948, to excavate some of these burials. However, I had to proceed shortly afterwards to Śiśupālgarh to take part in the excavation there and could not therefore open up more than one burial.

The work was undertaken in close collaboration with the State Department of Archaeology and with the assistance of Shri N. R. Banerji. For the preparation of photographs and drawings illustrating this article my thanks are due to Shri Munuswami Naicker, Photographer, and Shri Bhaskaran Nair, Draftsman of the Southern Circle, and to Shri L. Dutt and Shri Ram Prakash Khare of the Excavations Branch of the Department.

An account of this short excavation has already been published,[2] but the description is in many ways incorrect. The main objective of this paper is, therefore, to present the results of the excavation in a systematic and correct way.

2. SCOPE OF THE WORK

The Kerala region, the south-western coastal strip of India, is situated between the Western Ghats and the Arabian Sea. Being walled up from the mainland, it naturally developed certain individualities of culture which are also manifest in the funeral customs. The characteristic megalithic monuments of this area, viz. the *ṭopi-kals* or umbrella-stones, *kuḍai-kals* or hood-stones and rock-cut caves,[3] do not occur elsewhere. Apart from these, multiple dolmens, port-hole cists, menhirs and urns are also met with in this area. Variants of the latter types are encountered in other parts of south India as well, notably in Coorg and Coimbatore, Salem, Madurā, Chingleput and Tinnevelly Districts of Madras. A survey of three regions, viz. Chingleput District and the former States of Pudukkoṭṭai and Cochin, undertaken in the years 1944-48, revealed that the monuments in each zone, although belonging to a common megalithic complex, as attested to by their sepulchral nature and the use of iron and black-and-red pottery, differed considerably from each other in structural details and type.[4] The exact nature of these monuments, however, remained to be established by careful digging. Choice fell first upon the monuments in Cochin State. Instead of taking a monument peculiar to the Kerala region, it was decided to start with a type which is common both to Kerala and Tāmilnāḍ (pl. I), so that the evidence revealed at one place could be usefully employed for the other and correlation made possible. Porkalam provided the desired coincidence. Here, in addition to the rock-cut caves, also existed dolmens, port-hole cists within stone circles and urns. Since the rest of the available types were either disturbed or already excavated, a beginning was made with the urn-type.

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[1] V. D. Krishnaswami, 'Prehistoric Cochin', paper read at the 34th Indian Science Congress, Anthropology and Archaeology Section, Delhi, 1947.

[2] *An. Rep. Arch. Deptt., Cochin State, op. cit.*, pp. 14-16.

[3] L. A. Krishna Iyer, 'The prehistoric archaeology of Kerala', *Modern Review*, March 1946, pp. 182-90 ; V. D. Krishnaswami, 'Megalithic types of south India', *Ancient India*, no. 5 (1949), pp. 38-41.

[4] Krishnaswami, 'Megalithic types', pp. 36-41.

The urn-burial is perhaps the simplest of the megalithic monuments.[1] The structural details are as follows. First, a circle was demarcated on the surface with dressed or unhewn blocks of stones, which, in many cases, are now missing. In the centre, a pit of a convenient size, slightly wider than the maximum diameter of the intended urn, was scooped out with a rough stepping on one side. The lower portion of the pit was made conical to hold firmly the urn, normally pyriform in shape. In this otherwise cylindrical pit, the funeral furnishings were placed in two fillings : (*a*) within the urn and (*b*) overlying the urn. The monument was finally sealed with a capstone.

3. CHRONOLOGY

The date of the megalithic tombs in India still remains, to a great extent, a problem. There is in fact no means of ascertaining their date unless each type of monument in different regions is excavated and correlated, if possible, with a corresponding town-site. In recent years considerable attention has been directed towards a thorough survey of the monuments, and though a comprehensive list is yet to be prepared, the amount of information we now possess about them is quite encouraging. As, however, much still remains to be collected, any dating of these monuments at this stage will necessarily be provisional.

Sepulchral urns have so far been recorded at Ādichchanallūr,[2] Korkai and Kāyal[3] in Tinnevelly District, Pallāvaram and Perianattam in Chingleput District, Dadampatti and Paravai in Madurā District[4] and Wynāḍ[5] and Travancore[6] on the Malābār coast. At none of these places was any specific date ascribed to them.[7] The Porkalam urn-burial resembles in essential details that at Dadampatti, where the dual distribution of the funeral furnishings is also noticed. Neither of these sites can, however, be dated independently by the recovered objects. Further, in the absence of a habitation-site in the vicinity of Porkalam, a correlation of this typical megalithic culture with any corresponding culture at such a site has not been possible. However, it is to be noted that the technique and fabric of the pottery recovered from this monument (below, pp. 8 ff.) are absolutely identical with the megalithic ware of Brahmagiri and other sites in south India. Although a majority of the pottery-types differs at each place, this identity of fabric, partially supported by the similarity of rudimentary forms, is not without meaning. Furthermore, the use of iron, a necessary adjunct of the southern megalithic culture, is attested to at all these sites. An inter-relationship in the south Indian megalithic complex is therefore obviously indicated. One phase of this culture has been dated at Brahmagiri to a period between *circa* 200 B.C. and the middle of the first century A.D.[8]

---

[1] For a comparative study, see K. de B. Codrington, ' Indian cairn-and-urn-burials ', *Man*, special India number, XXX, no. 10 (October, 1930), pp. 190-96.

[2] Alexander Rea, ' Prehistoric antiquities in Tinnevelly ', *An. Rep. Arch. Surv. Ind.*, 1902-03 (Calcutta, 1904), pp. 111 ff.

[3] R. Caldwell, ' Explorations at Korkai and Kāyal ', *Indian Antiquary*, VI (Bombay, 1877), pp. 80-83.

[4] Alexander Rea, ' Some pre-historic burial places in southern India ', *Jour. Asiatic Soc. Beng.*, LVII, pt. I (1888), pp. 48 ff.

[5] L. A. Cammiade, ' Urn burials in the Wynaad, southern India ', *Man, op. cit.*, pp. 183-87 ; for more sites in Madras, see ' Observations upon ancient sites in the neighbourhood of Kalugumalai, Madras Presidency ', *ibid.*, pp. 187-89.

[6] Caldwell, ' Sepulchral urns in southern India ', *Indian Antiquary*, VI (Bombay, 1877), pp. 279-80.

[7] The Ādichchanallūr urn-burials have been vaguely considered to be contemporary with the Pāṇḍyans. Cf. Rea in *An. Rep. Arch. Surv. Ind.*, *op. cit.*

[8] R. E. M. Wheeler, ' Brahmagiri and Chandravalli 1947 : megalithic and other cultures in Mysore State ', *Ancient India*, no. 4 (1947-48), pp. 200-02 ; also Appendix C, p. 300.

The only factor at Porkalam, which can serve as a cross-check to the above dates, is the occurrence of etched carnelian beads (fig. 5 ; pl. V B), some of the designs of which, notably nos. 1, 2 and 5, are closely paralleled elsewhere and are dated to about the first century A.D. (below, p. 14). This agrees with the terminal date of the Brahmagiri megalithic culture, arrived at with a fair amount of precision after the consideration of the evidence from town-sites like Arikamedu and Chandravalli. The lower limit of the Porkalam urn-burial monuments is rather difficult to determine. We have to borrow the indirect evidence of the megaliths at Sulur in Coimbatore District, where, amongst other things, etched carnelian beads (although with different designs) were found in association with a bronze coin of Eran struck in the third or second century B.C.[1] Two of the Porkalam beads, nos. 9 and 11, having rough analogues at Bhīr Mound, Taxila (below, p. 16), would also support this date. The Porkalam urn-burials seem, therefore, to belong to a period ranging from *circa* third century B.C. to first century A.D.[2]

4. DESCRIPTION OF THE MONUMENT (fig. 1 ; pls. II-IV)

The monument consisted of a circle of dressed laterite blocks with an average external diameter of 16 ft. In the centre was a granite capstone flush with the ground (pls. I B and II A). The granite must have been imported from the neighbouring outcrop, three-fourths of a mile away, which is the nearest quarry. The major axis of the monument was 291° magnetic (March, 1948).

The excavation revealed in the centre a cylindrical pit, on an average 3 ft. in diameter and 4½ ft. in depth (pl. II B). The pit seemed to have been further dug in a conical section into the hard laterite rock to a depth of 9 in. On the south-eastern side was noticed a rough step or shallow ramp, 9 to 10 in. in depth, presumably to assist in the arrangement of funerary furnishings.

At the bottom of this pit was placed a pyriform urn, with a truncated round base, 3 ft. 2 in. in height and 1 ft. 9 in. in diameter at the mouth and 2 ft. 9 in. at the bulge (fig. 4 ; pl. III). Inside the urn, at its base, lay the following objects (pl. IV A) :—

1. Seven pots (pls. IV A and V A). The pots seem to have been shaken from their intended position. The bones which were presumably deposited in the central pot with a lid on were found in a mess badly crushed below the pot and the ring-stand.
2. Three iron implements (fig. 6 ; pl. VI). One tanged dagger, 11½ in. long and on an average 1½ in. wide, was lying flat on the brims of two bowls (pl. IV A), the other two, 6 in. and 5 in. long respectively and of indeterminate use, were resting against the conical side of the urn.
3. Fortyeight beads, fortyone of which were of etched carnelian. These belonged possibly to two strings which were hung from the terracotta hooks provided immediately below the neck of the urn. These beads, together with the two hooks, were collected from the base of the urn after removal of the pots.

Above the pots there was no filling ; the subsequent filling amounting to a few inches only must have percolated through the top. The urn was covered with a lid (fig. 4). The pit was also packed upto the level of the lid.

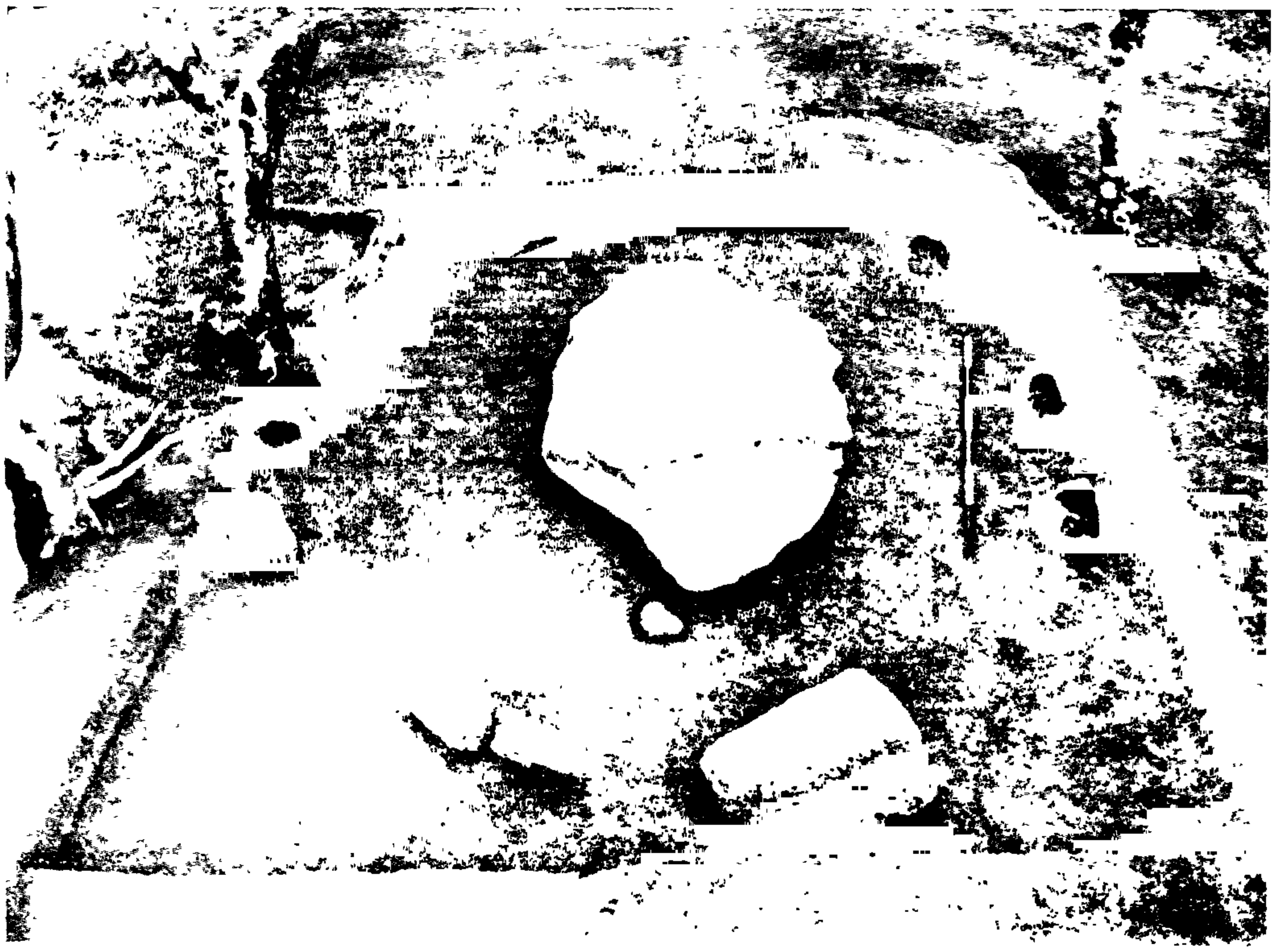
Overlying the lid was arranged the bulk of pottery, being a group of not less than eighteen pots (pl. IV B). Above these the pit was filled up with gravelly loose earth to the ground-level to form a low mound, over which rested the capstone. There was no occupation on the site prior to the building of the monument.

[1] H. C. Beck, 'Notes on sundry Asiatic beads—beads from megalithic tombs and midden in Sulur taluk and neighbouring districts', *Man*, *op. cit.*, p. 172.

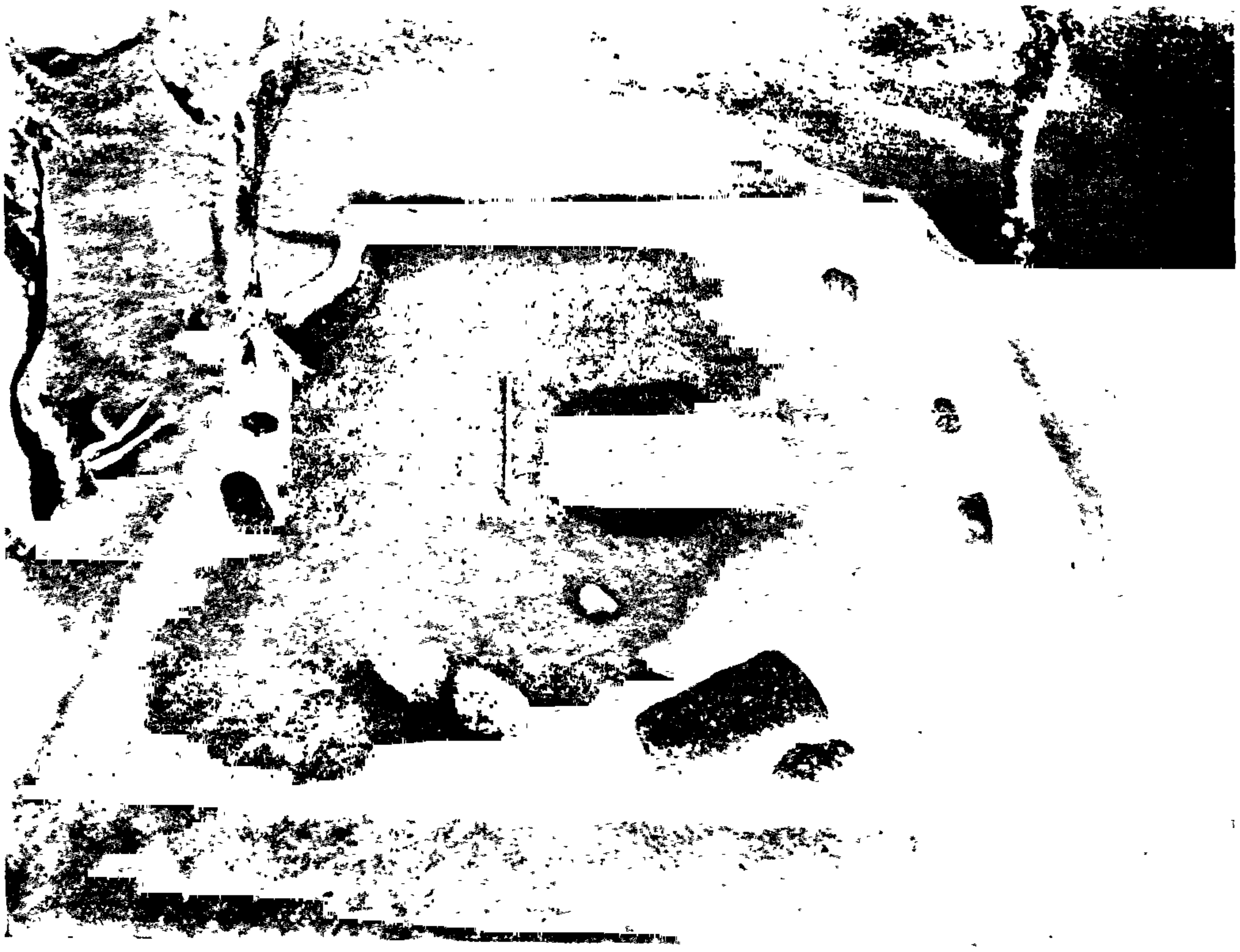
[2] See also Codrington, *op. cit.*, p. 196.

A. *Stone circle, with capstone flush with the ground, at Penmai, Chingleput District (see page 4)*

B. *Porkalam: close view of the monument showing the low tumulus below the capstone*

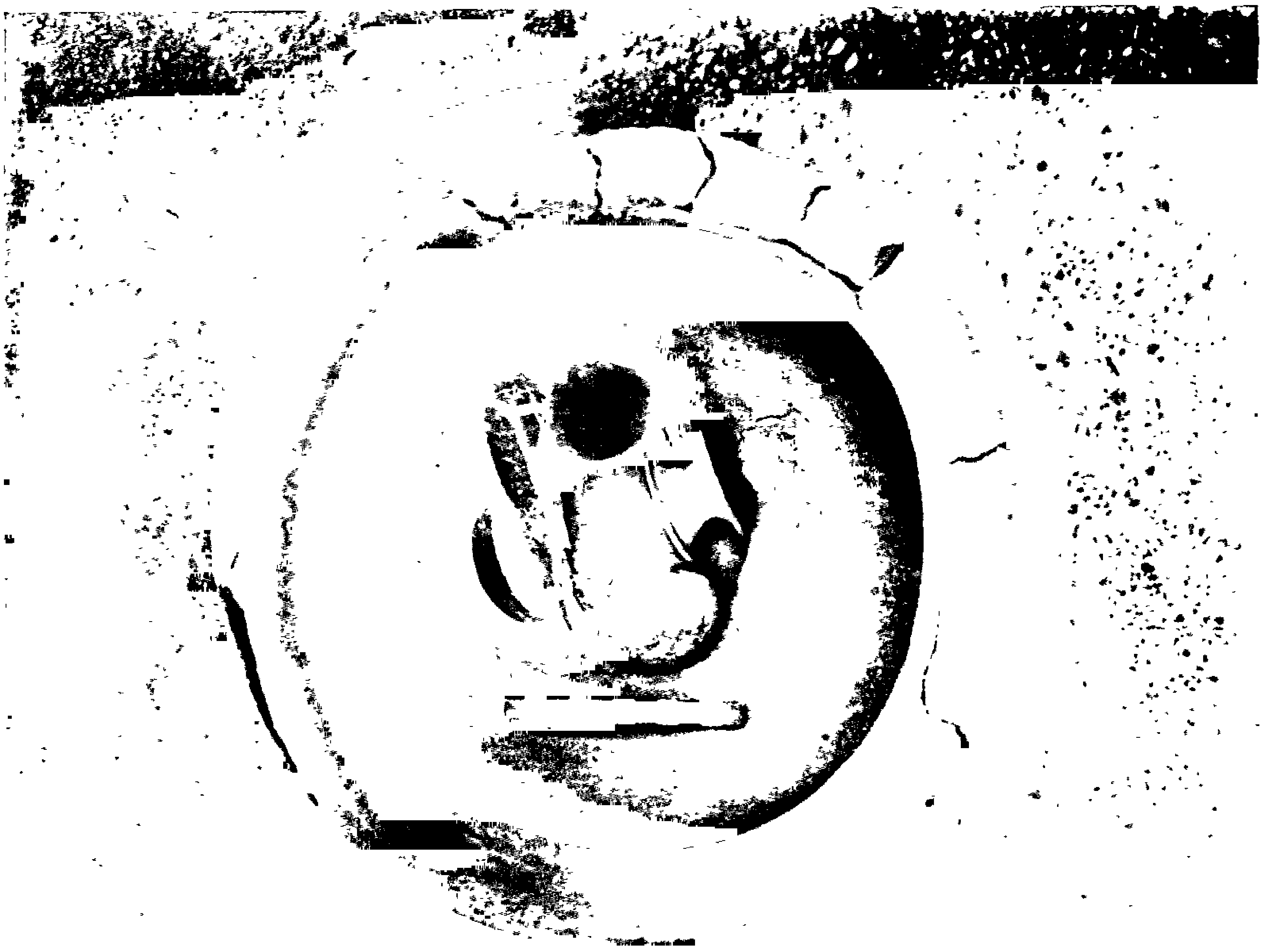


A. *View of the monument after clearance*



B. *View of the monument after removal of the capstone*

The pyriform urn in situ (*see page* 6)



A. *Close view of the deposits inside the urn. The hooks provided below the neck of the urn are also to be seen (see page 6).*

B. *Close view of the pottery-group in the upper deposit of the pit. In the centre can also be seen the lid covering the urn (see page 6).*

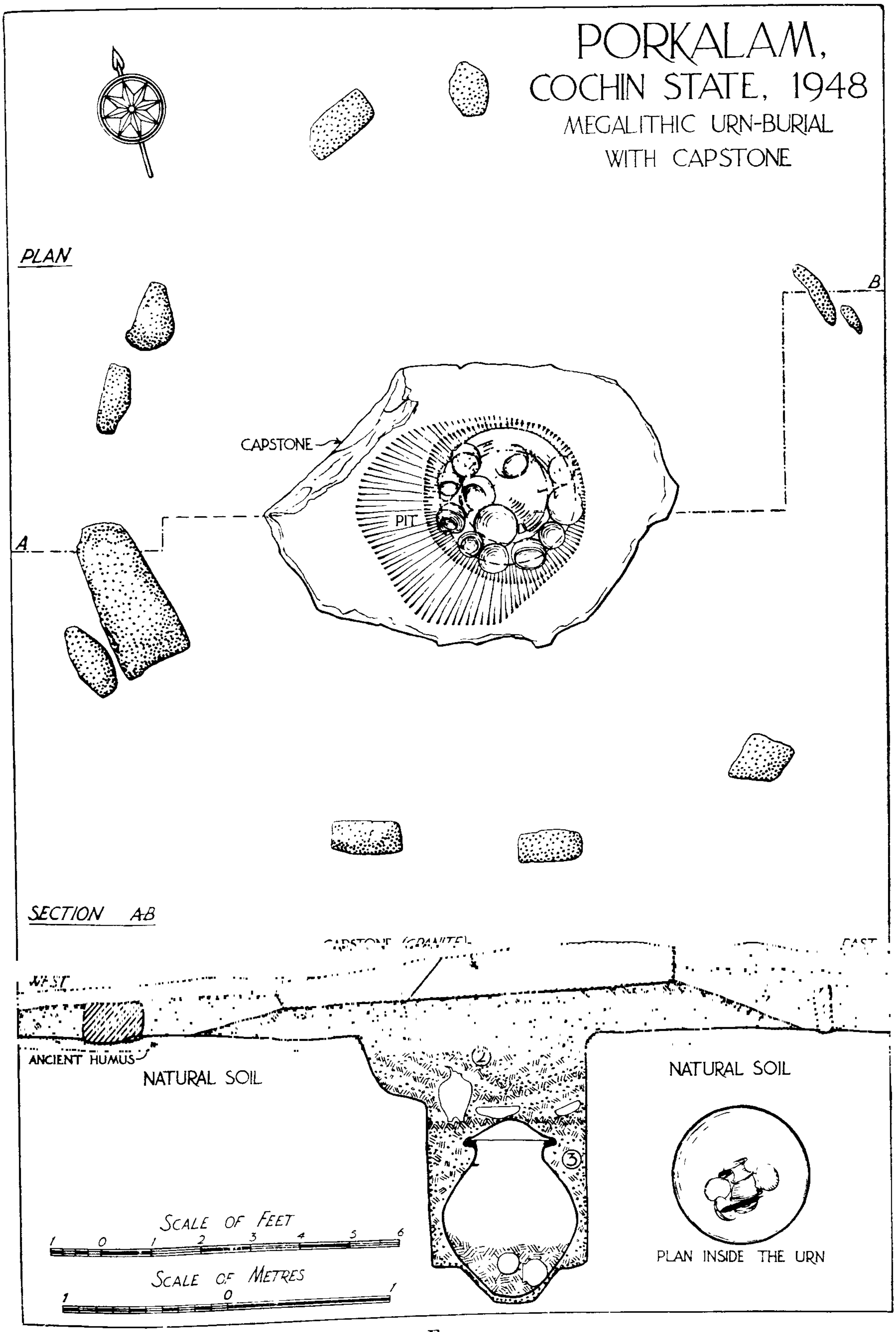

PORKALAM,
COCHIN STATE, 1948
MEGALITHIC URN-BURIAL
WITH CAPSTONE
PLAN
CAPSTONE
PIT
A
B
SECTION AB
WEST
EAST
ANCIENT HUMUS
NATURAL SOIL
NATURAL SOIL
PLAN INSIDE THE URN
SCALE OF FEET
SCALE OF METRES

FIG. 1

5. THE POTTERY

The entire range of the pottery recovered from this monument is wheel-made seemingly on a slow wheel;[1] the only exceptions to this rule are the big pyriform urn and the four-legged vases, of which the lower part alone including the legs is hand-modelled. The larger portion of this pottery belongs to the well-defined class of black-and-red ware, produced by inverted firing under reducing and oxidizing conditions of the kiln. It has usually a burnished surface which shows crackles, presumably caused by salt-glazing. The paste, although sufficiently graduated, is not consistently fine and contains a small amount of fine gravel as tempering material. The core, which is normally grey, shows air-holes at places. Before firing the pots were wet-smoothed and thereafter dressed with a coating of slip. They seem to have been fired at a low temperature since the body is not hard enough and easily crumbles if the pots are kept in water for long.

The all-black ware, of which there are six examples, was fired under completely reducing conditions. The types represented in this ware are : lids (fig. 2, 8 and 9) ; ring-stands (fig. 2, 14-16) and a deep bowl (fig. 2, 6). Red-slipped ware is also present, but its range is confined to four-legged vases (fig. 3, 17 and 18) ; an ordinary vase (fig. 2, 13) ; and the pyriform urn and its lid (fig. 4).

In technique and fabric this megalithic pottery resembles that from Brahmagiri and other megalithic monuments in the Deccan and the south. Beyond that there seems to be no correspondence between these industries except for the similarity of such rudimentary types as the bowl and the dish (fig. 2, 1-7).[2] Salt-glazing, which seems to be a normal feature of the Porkalam megalithic ware, is completely absent from the megalithic pottery of Brahmagiri, although it is present in the same region on the megalithic pottery from Chandravalli.[3] The latter two sites also do not yield ring-stands which are common at Porkalam and other sites in Cochin, as also in Tinnevelly, Chingleput, Salem, Madurā and Coimbatore Districts of Madras.[4] Similarly the graffiti on the pots at Porkalam do not agree with those on the Brahmagiri ones. The lid at Brahmagiri has a ring-terminal,[5] while that at Porkalam is flat at the top (fig. 2, 8 and 9). Lids with ring-terminals, however, occur in the pottery recovered from the megalithic caves at Kaṭṭakampal,[6] Cochin, and the 'megalithic' strata at Arikameḍu.[7] A distinctive pot at Porkalam is the four-legged vase (fig. 3, 17 and 18), of which again there is no parallel at Brahmagiri, where, in the cists, three-legged vases were encountered.[8]

In the geographical region called Kerala quite a number of monuments have been opened.[9] These include rock-cut caves, dolmens and cist-circles. The recovered pottery is not unlike that of Porkalam. Four-legged vases occur commonly in these

---

[1] The mechanism termed as slow wheel consists of a flat slab of stone or the base of a broken pot or large dish on which the clay can be slowly revolved with one hand while it can be shaped with the other.

[2] Cf. *Ancient India*, no. 4, p. 210, fig. 9, C8 ; p. 233, fig. 24, T86 and T87 ; p. 211, fig. 10, C13.

[3] *Ibid.*, p. 274, n. 1.

[4] References as above. The pottery is housed in the Government Museum, Madras.

[5] *Ancient India, op. cit.*, p. 217, fig. 13, P2.

[6] Pottery available in the Archaeological Museum, Trichur.

[7] J. M. Casal, *Fouilles de Virampatnam-Arikameḍu, rapport de l'Inde et de l'occident aux environs de l'ère Chrétienne* (Paris, 1949), p. 51, fig. 18, 60.

[8] *Ancient India, op. cit.*, p. 213, fig. 12, C25 and C25a.

[9] M. D. Raghavan, 'The rock-cut caves of Malabar', *Krishnaswami Aiyangar Commemoration Volume* (Madras, 1936), pp. 384 ff.

monuments.[1] Significantly enough some of the megalithic tombs in Coorg[2] and Cochin have yielded both the three-legged and the four-legged vases. The form of the four-legged vases at Porkalam is roughly paralleled by that of the three-legged ones recovered from Savandurga.[3]

We have, therefore, different local industries sharing a commonness in pottery-fabric and evidently belonging to the same culture-complex but having no specific resemblance between the pottery-types of each other. Identity of fabric, partially supported by some similarities of form, does, however, suggest some inter-relationship.

The date of this pottery has been tentatively fixed (above, p. 5). There is no other available evidence to justify any revision at the moment.

The following select types are illustrated. Of these, nos. 1 and 2 are represented both in the deposit inside the urn and that overlying ; nos. 3, 6, 8, 10 and 14 are peculiar to the deposit inside the urn (pls. IV A and V A) while the remaining, nos. 4, 5, 7, 9, 11-13 and 15-18 occur only in the secondary deposit above the urn.

FIGS. 2-4

1. Bowl of black-and-red ware with a vertical sharpened rim and a round base. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed.

2. Bowl of black-and-red ware, variant of the above type but with a bluntly carinated profile. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed.

3. Bowl of black-and-red ware with a vertical internally sharpened rim and sides tapering to a flat base. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed.

4. Bowl of black-and-red ware with a vertical featureless rim, cylindrical profile and a flat base. It is further distinguished by a weak groove below the rim and also bears post-firing graffiti on the exterior. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed. It was found resting on a ring-stand and was covered with a lid.

5. Deep bowl of black-and-red ware with a closing internally sharpened rim, low girth and a round base. It bears a pre-firing incised lattice-pattern on the outside. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed. It was found resting on a ring-stand and had a lid upon it. Analogues exist at Tinnevelly.[4]

6. Bowl of polished black ware with an incurved featureless rim, globular profile and an imperfectly flat base. It is characterized by a depression at the rim evidently to receive the lid and post-firing graffiti at four places on the outside. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed. It was found lying with a lid on the mouth side (no. 8) and a ring-stand on the bottom side (no. 14). Originally, therefore, it must have had a lid over it and rested on a ring-stand (pl. V A). The skeletal remains found below the pot were probably deposited in it. Analogues occur at an urn-burial site at Ilanji, near Kortālum.[5]

7. Dish of black-and-red ware with a vertical internally thickened rim and sides constricted to a sagger base. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed. Analogues occur at Brahmagiri.[6]

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[1] W. Logan, ' Find of ancient pottery in Malabar ', *Indian Antiquary*, VIII (1879), pp. 309-11. Pottery available in the Government Museum, Madras, and the Archaeological Museum, Trichur.

[2] M. J. Walhouse, ' Archaeological Notes ', *Indian Antiquary*, IV (1875), p. 13.

[3] B. R. Branfill, ' On the Savandurga rude stone cemetery, central Maisur ', *Indian Antiquary*, X (1881), pp. 1-12.

[4] *An. Rep. Arch. Surv. Madras and Coorg*, 1902-03 (Madras, 1903), pl. VI.

[5] Caldwell, ' Sepulchral urns ', *op. cit.*, fig. 1 facing p. 279.

[6] *Ancient India*, *op. cit.*, p. 211, fig. 10, C13.

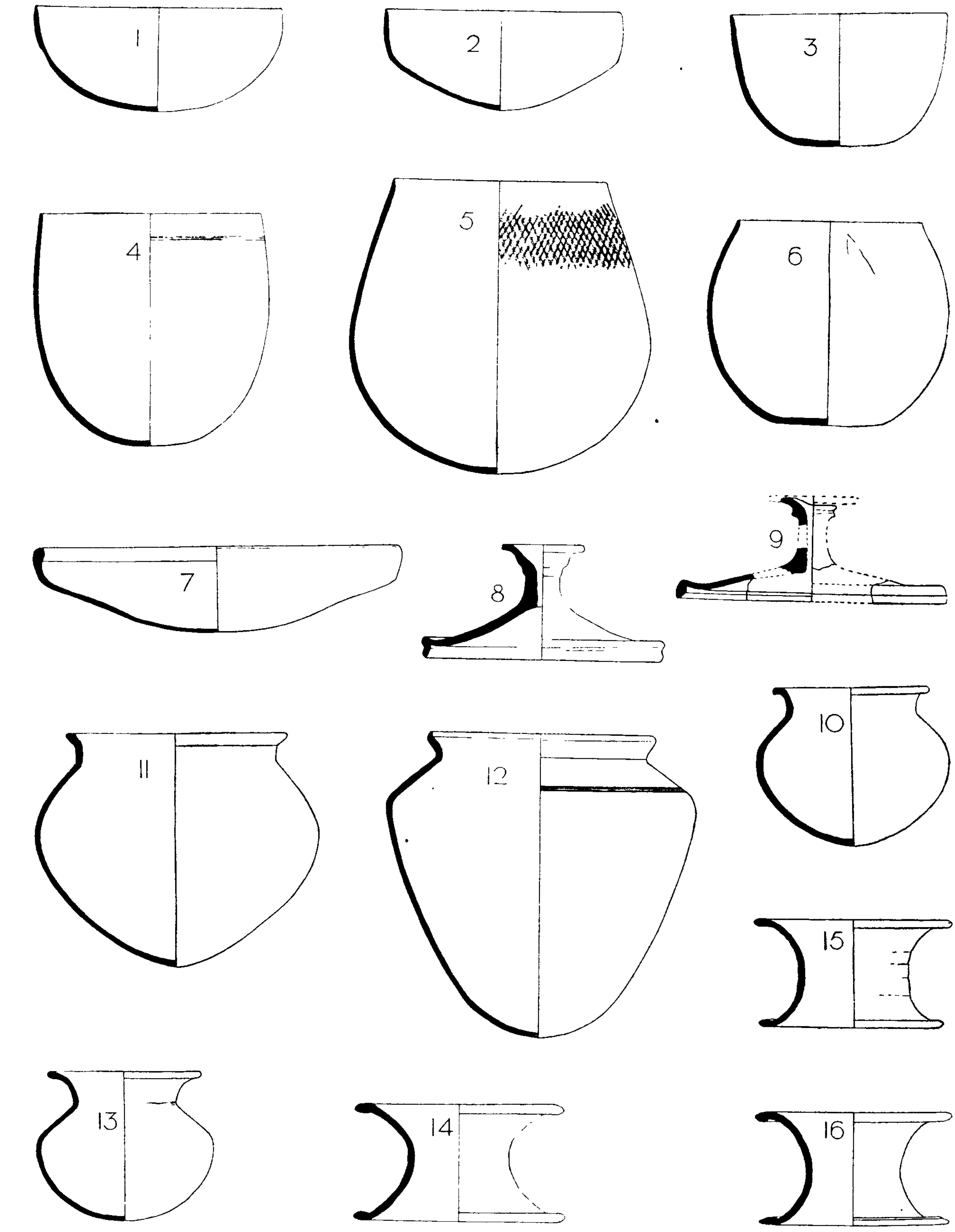

FIG. 2. *Pottery-types* 1-16. $\frac{1}{4}$

8. Lid of black ware with a short vertical externally grooved rim-base and hollow horizontally splayed-out terminal. Of fine fabric, it is treated with a slip both externally and internally.

9. Lid of black ware with a vertical internally thickened rim-base and a hollow horizontally splayed-out terminal. Of fine fabric, it is treated with a slip both externally and internally.

10. Vase of black-and-red ware with a horizontally splayed-out featureless rim, concave neck, globular profile and a rounded base. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed.

11. Vase of black-and-red ware with an everted externally thickened rim, short vertical neck, globular profile and a round base. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed.

12. Vase of black-and-red ware with a short vertical sharpened rim, internally ledged oblique shoulder, bluntly carinated, and a round base. It is characterized by a groove on the shoulder. Of fine fabric, it is treated with a slip both externally and internally and is salt-glazed. It was found resting on a ring-stand.

13. Vase of red ware with a flaring externally thickened rim, concave neck and a round base. Of fine fabric, it is treated with a slip only on the outside. It was found resting upon a four-legged vase (no. 17).

14. Ring-stand of black polished ware. Of fine fabric, it is treated with a slip both externally and internally. Analogues occur abundantly at Ādichchanallūr,[1] Arikamedu[2] and sites in Coimbatore and Chingleput Districts[3] and in Cochin.[4]

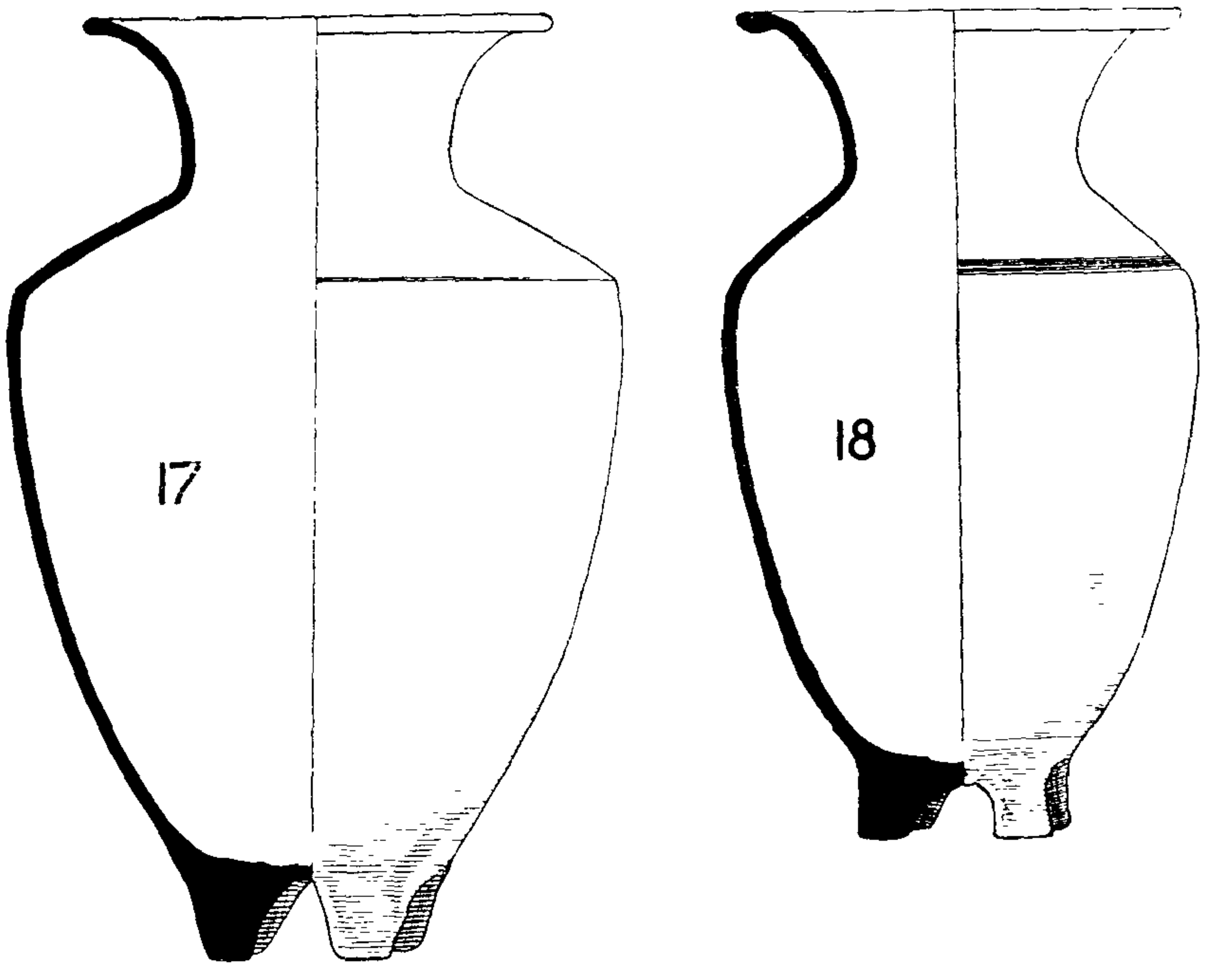

FIG. 3. *Pottery-types* 17 *and* 18. $\frac{1}{4}$

[1] Alexander Rea, *An. Rep. Arch. Surv. Madras and Coorg, op. cit.*, pl. VI.
[2] J. M. Casal, *op. cit.*, p. 52, fig. 19, 62.
[3] Pottery in the Government Museum, Madras.
[4] Pottery in the Archaeological Museum, Trichur.

15. Ring-stand of black polished ware having weakly corrugated sides. Of fine fabric, it is treated with a slip both externally and internally.

16. Ring-stand of black polished ware having a recurved rim-base. Of fine fabric, it is treated with a slip both externally and internally.

17. Vase of red ware with a flaring featureless rim, vertical concave neck, oblique shoulder and a tapering profile. It is distinguished by four solid legs at the bottom which are hand-modelled. Of medium fabric, it is treated with a slip on the outside only.

18. Vase of red ware with a flaring externally oval-collared rim, concave neck, oblique shoulder and a tapering profile. It is distinguished by four solid legs at the bottom which are hand-modelled. Of medium fabric, it is treated with a slip on the outside only.

19. Lid of red ware with an externally elliptical-collared rim-base. Of medium fabric, it has not been treated with any slip or wash. It was found covering jar no. 20.

20. Pyriform jar of dull-red ware with an out-turned externally round-collared rim, convex shoulder and a globular profile tapering to a truncated round base. It is further distinguished by a double row of beaded finger-tip design in appliqué on the shoulder. Immediately below the neck on the inner side were five hooks, two of which had fallen down and were collected along with other contents. These were meant evidently for hanging something, say beads etc. (above, p. 6). A similar provision, referred to by Alexander Rea as ' horns ', exists in the burial-urns of Ādichchanallūr.[1]

6. OTHER SMALL FINDS

A. Beads

The monument yielded fortyeight beads, of which carnelian[2] alone accounted for fortyone, all being etched. The etching is invariably in white over the natural red surface. Of the remaining seven, one was of terracotta (fig. 5, 11 ; pl. V B, 11), while the rest were of an indeterminate metal.[3] In the latter material only two shapes are represented (fig. 5, 10 and 12 ; pl. V B, 10 and 12), of which one is a pendant.

Etched carnelian beads have been recovered from megalithic burials at Raigir[4] in Hyderabad, Sulur in Coimbatore District, Bilikambe[5] in the Nilgiris, Coorg,[6] Paravai[7] in Madurā District, the Shevaroy hills[8] in Salem District and Wynāḍ[9] on the Malābār coast.

None, however, was found at Brahmagiri. With the available data on the study of etched carnelian beads, it is difficult to date any type or design with any convincing measure of precision. In the Porkalam etched beads nine designs are met with. Some of these have a fairly wide distribution both in space and time, the most popular being the design

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[1] Alexander Rea, *An. Rep. Arch. Surv. Ind.*, *op. cit.*, p. 118.

[2] These have been erroneously designated as glass in the *An. Rep. Arch. Deptt. Cochin State*, *op. cit.*, p. 16.

[3] The material of these beads has not so far been analysed.

[4] H. C. Beck, ' Notes on sundry Asiatic beads ', *Man*, *op. cit.*, p. 168.

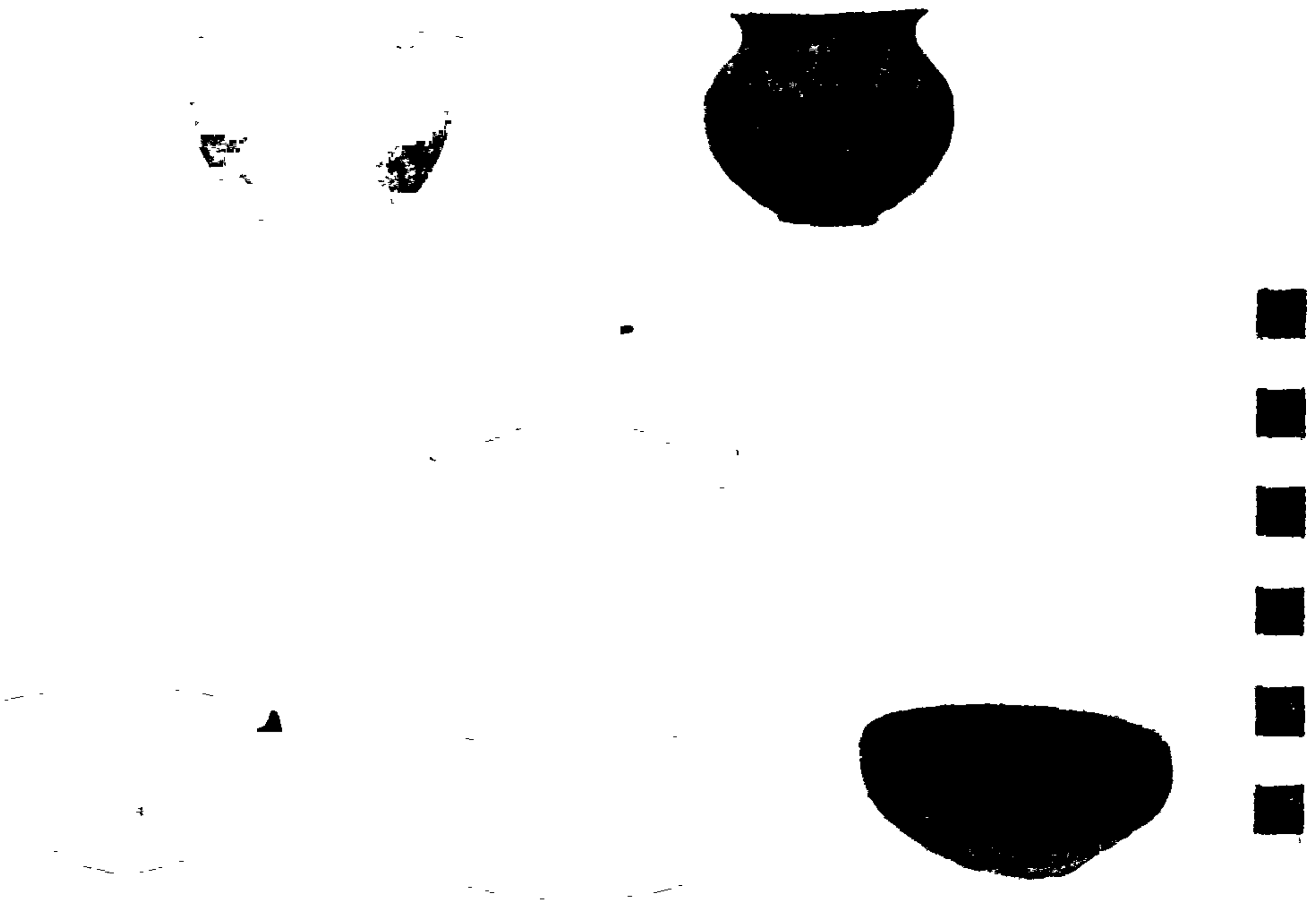
[5] Information from Dr. M. G. Dikshit.

[6] Walhouse, *op. cit.*, pp. 12-13.

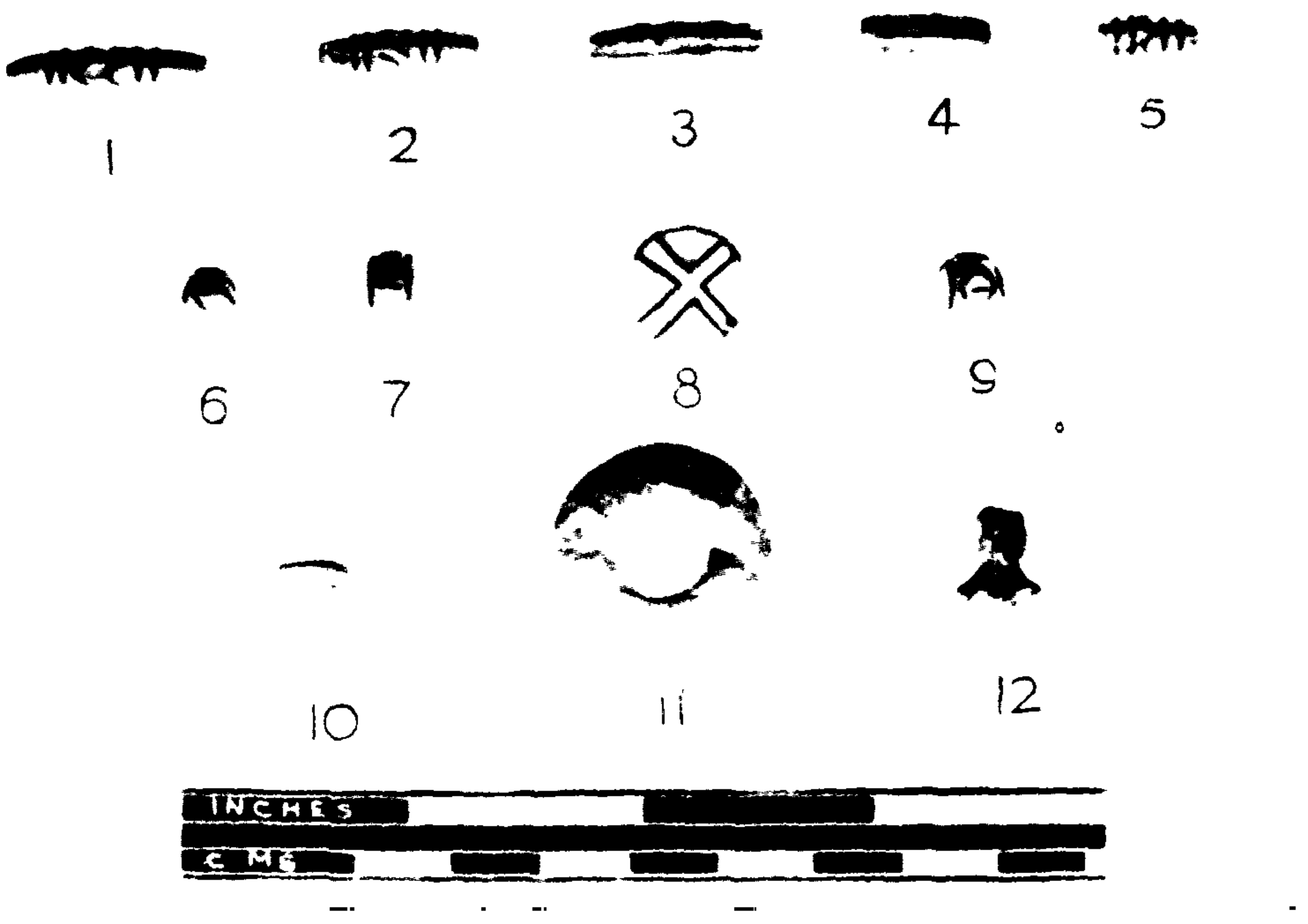
[7] Rea in *Jour. Asiatic Soc. Beng.*, *op. cit.*, p. 60, pl. X.

[8] R. Bruce Foote, *The Foote Collection of Indian Prehistoric and Protohistoric Antiquities, Notes on their Ages and Distribution* (Madras, 1916), p. 62 ; *Catalogue Raisonné*, p. 252 ; also Maurice Philips, ' Tumuli in the Salem District ', *Indian Antiquary*, II (1873), pp. 224-25.

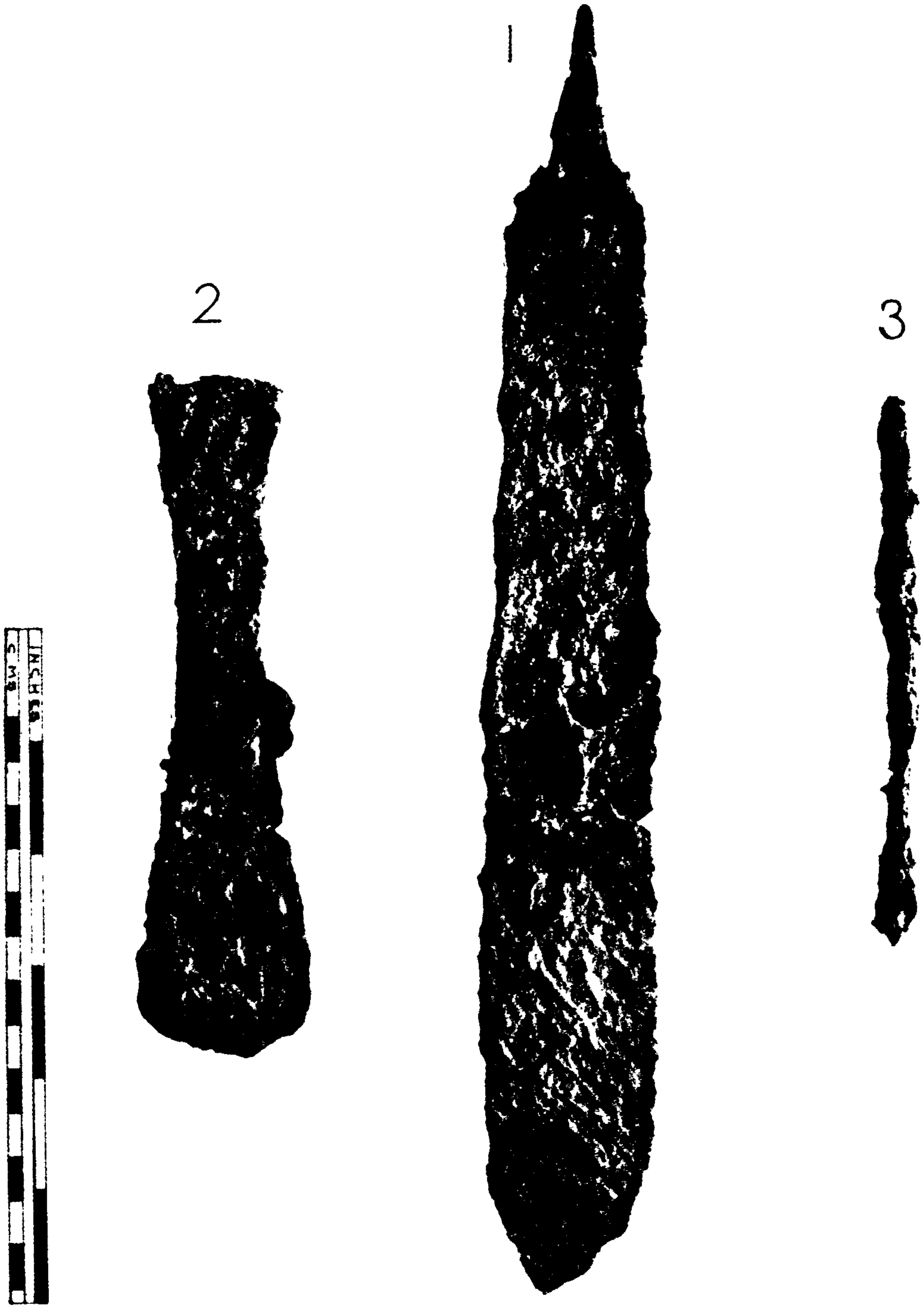
[9] H. C. Beck, ' Beads from urn burials in the Wynaad, Malabar coast ', *Man*, *op. cit.*, p. 175.



A. *Pottery recovered from inside the urn* (*see page* 6)



B. *Beads* (*see page* 12)



Iron objects (*see page* 16)

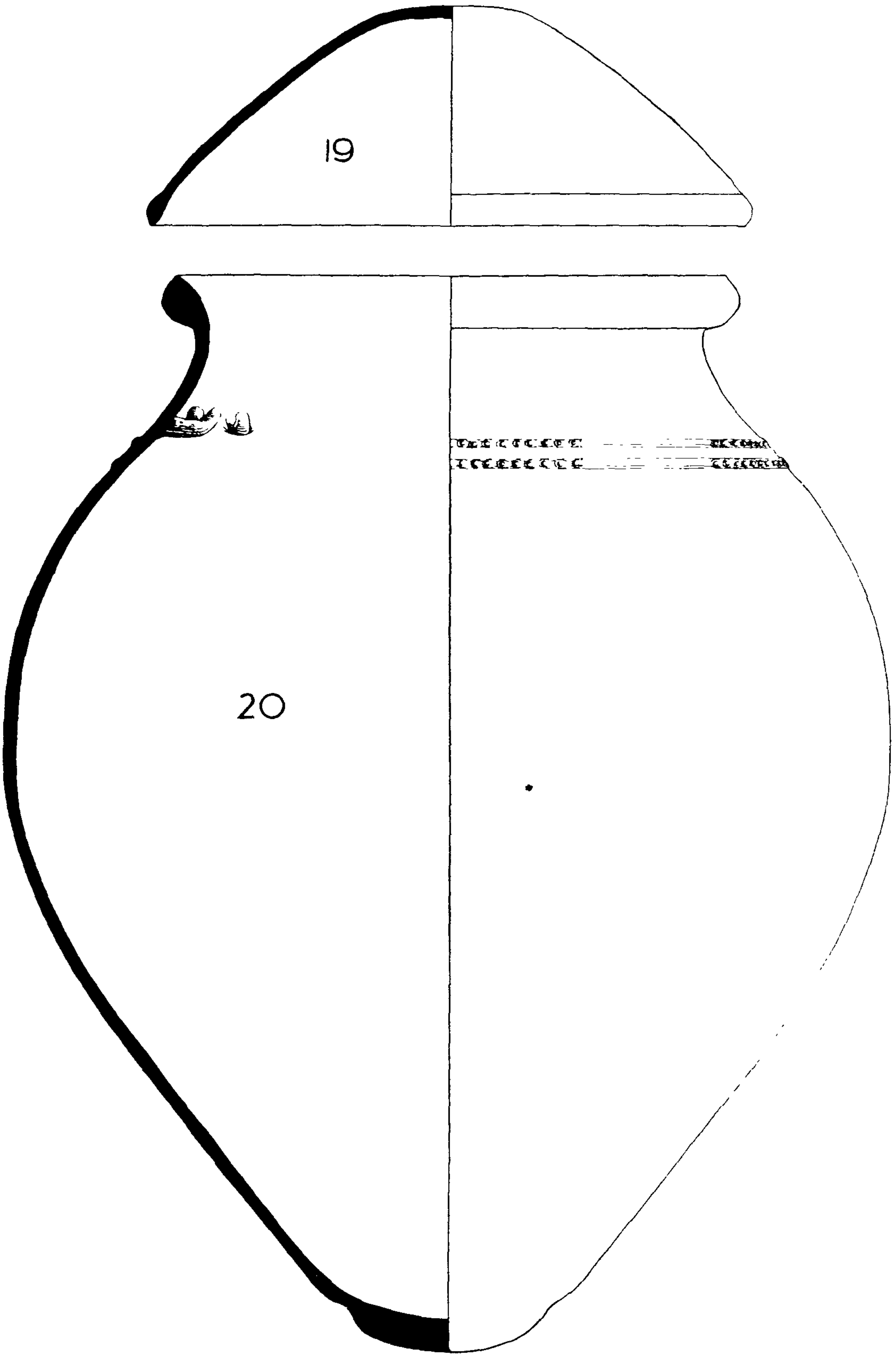


FIG. 4. *Pyriform jar with its lid.* $\frac{1}{6}$

on no. 1, double zigzag lines enclosed within marginal lines, represented by fourteen examples. It occurs on beads recovered from Brāhmanābād (unstratified),[1] Brahmapuri,[2] Maski[3] and Sangankallu.[4] As such this design had a long chronological range between the beginning of the Christian era and sixteenth century A.D. (being the date of the Brāhmanābād bead according to M. G. Dikshit). Allied to this is the design on no. 5, single zigzag line enclosed within two marginal lines, represented by a single specimen. Identical pattern occurs on beads from Kondāpur,[5] Maski[6] and Chandravalli.[7] These could be assigned to the early centuries of the Christian era. The design on no. 2, oblique strokes enclosed within two marginal lines, represented by five examples, occurs on a bead from Sirkap, Taxila, and is ascribed to the first century A.D.[8] A similar design appears on a bead from an 'earthen-ware tomb' at Paravai,[9] Madurā District. The resemblance is significant indeed. Another popular design is that on no. 7, represented by fourteen specimens. Exact parallels of this design are not known so far, but a roughly similar pattern occurs on some beads from Maski, Kauśāmbī and Sahri Bahlol[10] (Colonel Gordon's collection). A notable occurrence is that of a cross-design appearing on no. 8, of which two examples were recovered. Anologues occur at Maski[11] and Kauśāmbī,[12] although at both the sites the position of the cross is different from that at Porkalam. The design on no. 9 deserves special mention, since a roughly similar design has been recorded on a bead from Bhīr Mound, Taxila, assignable to *circa* fourth century B.C.,[13] Ahichchhatrā (surface-collection) and Kauśāmbī[14] (surface-collection).

From this comparative study it would appear that the central point in the chronology of these beads is *circa* first century A.D., leaving aside the Brāhmanābād specimen.

In the whole collection of etched beads only three types are available : (*a*) long barrel circular, nos. 1-5 ; (*b*) elliptical circular or spherical circular, nos. 6, 7 and 9 and (*c*) circular tabular, no. 8.

The different types and designs are described below :—

FIG. 5 ; PL. V B

1. Carnelian : long barrel circular ; etched in white with double zigzag lines enclosed within two marginal lines on either side ; fourteen examples.

2. Carnelian : long barrel circular ; etched in white with oblique strokes enclosed within two marginal lines on either side; five examples.

[1] M. G. Dikshit, *Etched Beads in India,* Deccan College Monograph Series 4 (Poona, 1949), pl. X, 22.

[2] *Ibid.*, pl. III, 15.

[3] *An. Rep. Arch. Deptt. H. E. H. the Nizam's Dominion,* 1936-37 (Calcutta, 1939), pl. XII A.

[4] Dikshit, *op. cit.*, pl. XVIII, 6.

[5] Dikshit, *Some Beads from Kondapur*, Hyderabad Arch. Series no. 16 (Hyderabad, 1952), pl. I, 2.

[6] Dikshit, *Etched Beads*, pl. XVII, 19 ; *An. Rep. Arch. Deptt. H. E. H. the Nizam's Dominion, op. cit.*

[7] Dikshit, *Etched Beads*, pl. XVIII, 17.

[8] H. C. Beck, *The Beads from Taxila*, Mem. Arch. Surv. Ind., no. 65 (Delhi, 1941), pl. II, 25 and p. 46.

[9] Rea, 'Some prehistoric burial places in southern India', *op. cit.*, p. 60, pl. X a.

[10] Information from Dr. M. G. Dikshit.

[11] Dikshit, *Etched Beads*, pl. XVII, 9.

[12] *Ibid.*, pl. XIII, 15.

[13] Beck, *The Beads from Taxila*, p. 45, pl. II, 8.

[14] Information regarding Ahichchhatrā and Kauśāmbī from Dr. M. G. Dikshit, who feels that 'the present specimen from Porkalam is the only bead with this pattern from south India'.

3. Carnelian : long barrel circular ; etched in white with longitudinal zigzag lines in four quadrants along the periphery ; one example.

4. Carnelian : long barrel circular; etched in white with oblique strokes enclosed within four longitudinal quadrants resembling herring-bone pattern ; one example.

5. Carnelian : long barrel circular ; etched in white with single zigzag line enclosed within two marginal lines on either side ; one example.

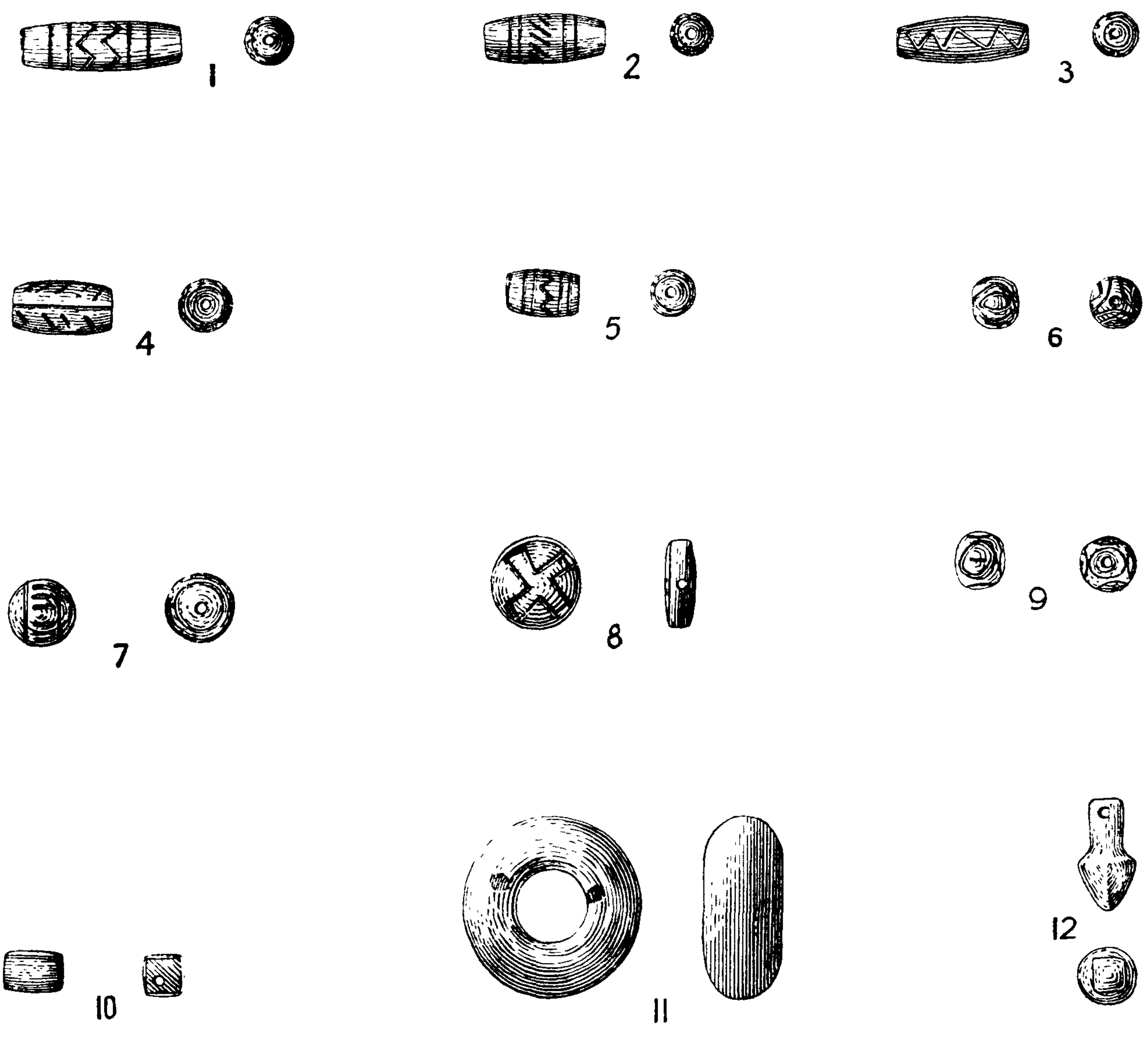


FIG. 5. *Beads.* $\frac{1}{1}$

6. Carnelian : standard elliptical circular ; etched in white with three circles on the body enclosing oval circles in imitation of the eye ; one example.

7. Carnelian : spherical ; etched in white with horizontal strokes enclosed within marginal lines, resembling ladder pattern ; fourteen examples.

8. Carnelian : circular tabular ; etched in white with a cross ; two examples.

9. Carnelian : standard elliptical circular ; etched in white with circles all over the body enclosing a dash ; two examples. Roughly similar design occurs on a bead recovered from Bhīr Mound, Taxila, ascribable to the fourth century B.C.[1]

10. Indeterminate metal : standard barrel square ; the perforation is not in the centre as seen in the transverse section ; two examples.

11. Terracotta : circular annular oblate ; one example. Analogue in bone occurs at Bhīr Mound, Taxila, and is dated fourth-third century B.C.[2]

12. Indeterminate metal ; plumb-bob type ; four examples. Pendants of this shape in metal are scarce, but their counterparts in terracotta occur at Rājghāṭ, Kauśāmbī and Arikameḍu.[3]

B. IRON OBJECTS (fig. 6 ; pl. VI)

Only three iron objects were recovered from this monument. All of these, as already stated (above, p. 6), were found lying in the pyriform urn along with the pottery. Iron objects occur abundantly in the excavated megalithic monuments of Brahmagiri (Mysore State), Ādichchanallūr (Tinnevelly District), Perumbair (Chingleput District), Kil. Mondambadi near Shevaroy Hill (Salem District), Periyakulam taluk (Madurā District) etc. Iron is in fact one of the necessary adjuncts of the southern megalithic culture. Of the three objects, no. 1, viz. tanged knife or dagger (fig. 6, 1 ; pl. 6, 1), is the commonest type appearing in all these megalithic monuments.[4]

1. Tanged knife or dagger with a roughly rectangular section.

2. Object of indeterminate use (probably a blade) with an oblong section.

3. Object of indeterminate use (probably a spike) with an oblong section.

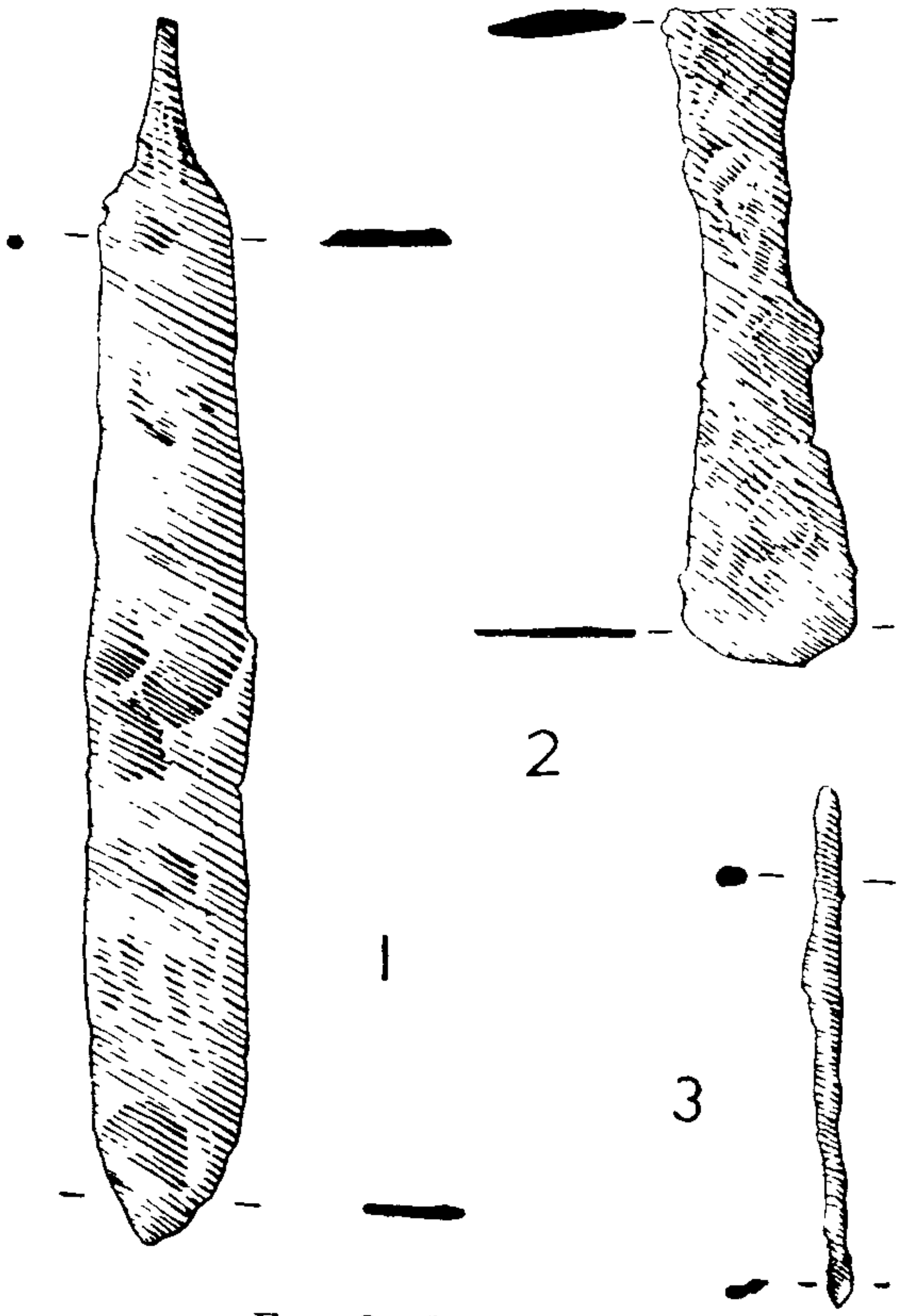


FIG. 6. *Iron objects.* 1/3

[1] See above, p. 14, n. 13

[2] Beck, *The Beads from Taxila*, p. 61, pl. X, 18.

[3] Information from Dr. M. G. Dikshit.

[4] *Ancient India, op. cit.*, pp. 254-57, figs. 36 and 37.

EXAMINATION OF SOME ANCIENT INDIAN GLASS SPECIMENS

By B. B. Lal

In this article Dr. B. B. Lal, Archaeological Chemist in India, critically discusses the chemical constituents of a few ancient Indian glass samples, some of which were analysed and reported on previously and others have been analysed by him for the first time. The present data are admittedly very limited for tracing the chronological and regional developments of ancient glass-making, but when more material of the nature made available in this article is forthcoming, it will be possible to trace the full history of the industry.

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1. INTRODUCTORY

THE origin of glass can be traced to remote antiquity, though when it was first manufactured is an open question.

Actual glass was practically unknown in Predynastic Egypt or in the Old Kingdom, and the occurrence of an impressed Hathor head in a Predynastic grave of Sequence Date 41 has been attributed by Petrie to importation.[1] He is also of the opinion that other specimens of the earliest glass, such as beads from Predynastic burials[2] were not indigenous to Egypt and those from the First Dynasty and earlier periods were imported from Asia.[3] The artificial manufacture of glass can, according to him,[4] be traced as far back as 2500 B.C. in Syria and 1500 B.C. in Egypt,[5] where glass of local manufacture is plentiful in the Eighteenth Dynasty, the oldest piece with the date 1551-1527 B.C.—a large ball bead now in the Ashmolean Museum, Oxford,[6]—coming from this period.

There is some evidence to show that Mesopotamia might have been the cradle of glass-industry. Glass beads have been found in large numbers in the excavation of a Third Dynasty cemetery at Ur.[7] The earliest specimen of glass (blue glass in lumps) as yet recorded in Mesopotamia comes from Abu Shahrein, in a deposit earlier than the Third Dynasty of Ur (2100 B.C.).[8] Morey has discussed some important problems of

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[1] Petrie, *Prehistoric Egypt* (1920), pp. 43, 110.

[2] McIver and Mace, *El Amroh and Abydos* (1902), p. 54.

[3] Petrie in *Trans. Newcomen. Soc.*, 5 (1924-25), p. 72.

[4] Petrie in *Jour. Soc. Glass Tech.*, 10 (1926), p. 229.

[5] Lucas, *Ancient Egyptian Materials and Industries* (1934), p. 408 ; Morey, *The Properties of Glass* (1938), p. 12.

[6] Lucas, *op. cit.*, p. 116 ; Morey, *op. cit.*, p. 12.

[7] Woolley, *Ur Excavations*, II (1934), p. 366.

[8] Hall, *The Civilization of Greece in Bronze Age* (1928), pp. 71, 104,

ancient glassware,[1] and Thompson has discussed in detail the manufacture of glass as gleaned from Assyrian cuneiform tablets.[2]

The history of Persian glass is very incompletely known.[3] There is no literary document giving information on the production of glass in Iran in remote antiquity.

Until recently it was believed that the earliest specimens of Chinese glass had really been importations from Egypt, and that glass-making became an indigenous industry in China only about the fifth century A.D. It has, however, now been established that glass of indigenous manufacture was in use in China in 550 B.C.[4] Williamson speaks of Chinese glass made from the rocks in the neighbourhood.[5] The rocks must have been quartz, an interesting analogy being furnished by Pliny's statement about Indian glass (see below).

The origin of Indian glass is obscure, but there is no doubt that it was known in pre-Christian centuries. According to Mitra, glass was manufactured in Ceylon in the third century B.C.,[6] and Buch has drawn attention to the fact that the *Arthaśāstra* (probably of Mauryan date, fourth century B.C.) describes false gems as glass gems and mentions the manufacture of glass.[7] Coomaraswamy is of the opinion that the art of glass-making attained a high degree of perfection even in pre-Mauryan times.[8] According to Pliny, glass was made in India from fragments of rock-crystal, for which reason Indian glass was 'beyond compare'. He further states: 'the people of India by colouring crystal have found a method of imitating various precious stones, beryls in particular'.[9] This statement of Pliny has, however, been questioned by Kisa.[10] In Sanskrit literature glass is known as *kācha*, but no details are available about the technique of its manufacture.

Mohenjo-daro and Harappā, the cities of the third millennium B.C., have yielded a large variety of beads, bangles etc., mostly of steatite, paste or faïence. True glass is absent,[11] though glazed objects, such as pottery, terracotta beads, steatite and faïence have, no doubt, been found.[12] This is surprising, as the manufacture of glass is not in reality far removed from that of glaze and the Indus valley had cultural contacts with Mesopotamia, where glass-making was an established industry in the third millennium B.C. (above, p. 17).

The earliest specimens of authentic glass come from the pre-Mauryan levels of Bhīr Mound, the earliest Taxila, and some of the glass objects unearthed here represent the largest intact examples so far recovered in this country.[13] Most of them are coloured, and some exhibit a characteristic iridescence due evidently to decomposition and the deposition on the surface of lenticular flakes of silica. The lowest and middle strata of Bhīr Mound have yielded a large number of glass beads of excellent quality.[14]

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[1] Morey in *Discovery*, XI (1930), p. 61.
[2] Thompson, *Chemistry of Ancient Assyrians* (1925).
[3] Lamm, *Glass from Iran* (1935), p. 7.
[4] Sarton in *Isis*, 25 (1936), p. 73; White, *Tombs of Old Lo-Yang* (1934), p. 14.
[5] Williamson, *Journeys in North China*, I, p. 131.
[6] R. Mitra, *Antiquities of Orissa*, I (1875), p. 101.
[7] Buch, *Economic Life in Ancient India*, I (1924).
[8] Coomaraswamy, *History of Indian and Indonesian Art* (1927), p. 16.
[9] Pliny, *Natural History*, XXXVII, 20.
[10] Kisa, *Das Glas im Altertume* (1908), p. 106.
[11] Marshall, *Mohenjo-daro and the Indus Civilization*, II (1931), pp. 469, 574-82.
[12] *Ibid.*, pp. 366, 576-78; Vats, *Excavations at Harappā*, I (1940), p. 312.
[13] *An. Rep. Arch. Surv. Ind.*, 1919-20 (1922), p. 19; 1921-22 (1924), p. 125; 1922-23 (1925), p. 157.
[14] *Ibid.*, 1919-20 (1922), p. 24.

The art of glass-making had thus reached a high level of technical excellence before the third century B.C. Specimens of ancient glass have been found near Dargai village in the Malākānd Agency (now in Pakistan) along with an earthen pot, which appears to have been employed in manufacturing glass. Other specimens dealt with here come from Bhīṭā (near Allahabad), Nālandā, Assam, Kurukshetra, Udaigiri in Gwalior,[1] Ahichchhatrā in U.P.[2] and Arikameḍu near Pondicherry.[3] Excavation at Brahmagiri[4] has produced from the Āndhra levels (first-third centuries) a large number of glass beads and bangles of different colours. The chemical composition of these specimens is not known, as the material has not been examined.

Scientific examination of ancient glass has been carried out in the West,[5] but very little has been done in India in this direction. Though some reports are available,[6] most of them are incomplete, as physical properties, such as specific gravity, refractive index, strain etc., have not been studied. For want of adequate data on the composition and physical characteristics of firmly-dated specimens definite conclusions as to the source of the material and the technique of fabrication cannot be drawn. It is necessary to emphasize that for the determination of the origin of specimens, small amounts or traces of some ingredients are of paramount importance, and for the study of these minute traces of ' key-elements ', spectrography is a very useful technique and has been widely adopted in the West. For example, Ritchie and his collaborators have carried out spectrographic studies on ancient Egyptian glass with very important results.[7] Ritchie has also examined spectrographically Chinese glass from pre-Han to T'ang times.[8] Seligman and his co-workers have also carried out extensive investigations on ancient glass with particular reference to its origin.[9] Spectrographic analysis of glass could not, however, be carried out by the present author for want of laboratory facilities, and he had to content himself with chemical analysis. For the same reason, spectro-photometric methods could not be employed to ascertain what elements were used to produce colour.[10]

Subject to the above limitations, it was thought desirable to institute a systematic enquiry into this problem and to correlate the scattered literature on this subject, in order to assess the technical skill attained by the ancient artisans in this line. The published material has been critically examined and reinterpreted in the light of the data now available.

2. GLASS FROM TAXILA

Some specimens of ancient glass from Taxila have already been analysed.[11] These analyses are reproduced in Table I (p. 20).

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[1] *An. Rep. Arch. Surv. Ind.*, 1922-23 (1925), p. 158 ; 1930-34, II (1936), p. 300.

[2] See below, M. G. Dikshit, ' Beads from Ahichchhatrā '.

[3] *Ancient India*, no. 2 (1946), p. 96.

[4] *Ibid.*, no. 4 (1947-48), p. 263.

[5] Faust, *Antiques*, XXXII (1937), pp. 310-11.

[6] *An. Rep. Arch. Surv. Ind.*, 1922-23 (1925), p. 158 ; 1924-25 (1927), p. 139 ; 1930-34 (1936), p. 300.

[7] Farnsworth and Ritchie in *Tech. Studies*, VI, no. 3 (1938), pp. 155-68.

[8] Ritchie in *Tech. Studies*, V, no. 4 (1937), pp. 209-20.

[9] Seligman and Beck in *Nature*, CXXXIV (1934), p. 982 ; Seligman, Ritchie and Beck in *ibid.*, CXXXVIII (1936), p. 721 ; Seligman and Beck in *Bulletin of the Museums of Far Eastern Antiquities*, no. 10 (1935), pp. 1-64.

[10] Norton in *Antiques*, XXXII (1937), pp. 76-77.

[11] *An. Rep. Arch. Surv. Ind.*, 1921-22 (1924), p. 125 ; 1922-23 (1925), p. 158.

TABLE I

Specimens	1	2	3	4	5	6	7	8	9	10	11
SiO_2 ...	37·09	61·32	39·79	70·57	67·48	68·34	71·01	58·12	53·81	70·69	68·11
Fe_2O_3 ...	3·16	1·70	2·45	1·60	3·64	1·20	1·84	1·74	8·47	0·81	2·27
Al_2O_3 ...				2·46		1·67	3·74	5·74	1·51	2·88	2·22
PbO ...	34·85	Nil	38·93	...	...	...	...	...	...	...	...
SnO_2 ...	...	...	0·22	...	...	...	...	...	...	...	...
Sb_2O_3 ...	Nil	5·08	...	...	2·42	...	...	...	...	...	...
MnO ...	0·11	0·26	?	0·05	...	0·34	0·05	0·17	0·08	0·01	...
Cu ...	...	...	5·31	...	...	...	...	...	...	...	...
CuO ...	...	...	...	0·55	3·63	...	0·24	...	...	...	0·44
Cu_2O ...	7 20	Nil	...	...	...	...	...	...	...	...	...
CaO ...	6·46	9·74	2·81	4·60	4·92	8·44	3·73	8·85	6·27	7·05	4·91
MgO ...	0·70	1·64	?	2·68	1·80	1·44	2·32	4·01	4·50	0·50	3·74
Na_2O ...	10·33	20·26[1]	10·02	14·99	2·48	17·76	14·99	16·74	23·52	12·86	19·10
K_2O ...	0·87		0·57	2·65	0·55	0·94	2·65	4·83	2·35	4·85	...
H_2O ...	...	...	...	...	14·15	0·43	...	...	...	...	...
TOTAL ...	100·77	100·00	100·10	100·15	101·07	100·56	100·57	100·20	100·51	99·65	100·79

[1] K_2O > 1 per cent.

Description of specimens

1. Red opaque glass.
2. White opaque glass.
3. Thin drawn-out strips of haematinum.
4. Greenish blue glass tiles.
5. Turquoise blue powder of decomposed glass object.
6. Light green glass fragment from flask.
7. Greenish blue glass tile.
8. Amethyst glass fragments.
9. Brown glass fragments.
10. Thin curved fragment of light blue glass.
11. Blue glass bangle.

All these specimens are soda-lime glasses containing appreciable amounts of potash. Most of the specimens are free from air-bubbles.

Specimen 1, described as a red opaque glass similar to Roman haematinum, is very similar in composition to specimen 3, described as thin drawn-out strips of haematinum, as both contain an unusually high proportion of lead, which does not seem to have been found in any other contemporary or earlier glass, except in some blue Chinese beads of the Han period (second century B.C.), analysed by Beck and Seligman.[1] The amount of lead oxide in this specimen was found to be 24·5 per cent, and this is much lower than the lead-content of the two specimens from Taxila described above. The use of lead oxide in large quantities is a recent innovation introduced about the seventeenth century, when crystal glass was made in England. It is, therefore, significant that as early as fourth-third century B.C., craftsmen of Taxila were acquainted with the use of this compound in glass-manufacture. It was, however, not used on a wide scale, as it has been detected only in two examined specimens.

The white opaque glass (specimen 2) and the turquoise blue glass (5) contain a good amount of antimony. The presence of fairly large quantities of antimony is significant, as specimens from other countries have not been found to contain such a high percentage of this element. The addition of antimony in appreciable amounts in special glasses is again a recent development.

Magnesia is present in some specimens but the proportion is not very large, and some magnesia can be substituted for lime with advantage.[2] Small amounts of magnesia produce glasses which have a rapid melting rate and are easy to work, but high magnesia glass is hard to melt and has a greater viscosity than is produced by an equivalent amount of lime.

The use of small amount of potash such as is present in most specimens from Taxila is an advantage,[3] as it increases chemical durability and diminishes its tendency to devitrification.

Most of the specimens also contain a fairly large percentage (6 to 7 per cent) of lime. When too little lime is added, the glass is easy to melt but lacks durability,[4] while an increase in its proportion produces glass of good chemical durability.[5]

The specimens have a high alkali content (17 to 18 per cent); such glass would have been of a very poor quality had not lime been added in suitable proportions. At the same

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[1] Seligman and Beck in *Nature*, *op. cit.*

[2] Hodkin and Cousen, *Text Book of Glass Technology* (1925), p. 109 ; Morey, *op. cit.* p. 81.

[3] Hodkin and Cousen, *op. cit.*, p. 96.

[4] Morey, *op. cit.*, p. 80.

[5] Hodkin and Cousen, *op. cit.*, p. 110.

time, if the proportion of lime is much above 10 to 12 per cent, glass becomes difficult to work[1] and shows a greater tendency towards devitrification. Glass with high silica content (above 72 per cent) has a good chemical durability but becomes very hard and difficult to melt and tends to devitrify. No glass specimen from Taxila shows an unduly high proportion of silica.

Three complete conical flasks of sea-green colour were found at Sirkap, the second city of Taxila.[2] These, probably the largest specimens of intact ancient glass objects so far found in India, were formed by blowing glass. It has been concluded, therefore, that the Taxila craftsmen were acquainted with the art of glass-making and glass-blowing as well as with the more advanced art of decolourizing glass by means of manganese and colouring it with various metallic oxides. In fact, they confirm Pliny's statement (above, p. 18) that the Indians were skilled in the art of colouring glass to imitate precious gems.

Other important glass objects from Taxila include tiles found in the Dharmarājikā Stūpa erected during the reign of Aśoka (third century B.C.).[3] Here, excavation revealed a floor of glass tiles of bright azure blue and a few other colours, viz. black, white and yellow. These tiles average $10\frac{1}{4}$ in. square and $1\frac{1}{8}$ in. in thickness and are of transparent glass, the first complete specimens of their kind so far brought to light. They bear testimony to the specialized knowledge of moulding large objects and possibly also of annealing, for such heavy glass objects require considerable expert attention in annealing for removing internal strain. The state of preservation of the tiles and their freedom from fracture and devitrification demonstrate a high level of technical excellence in manufacture. It is interesting to recall here the Chinese tradition based on the annals of the Wei dynasty (A.D. 386-557) that glass-making was introduced by Indo-Scythian merchants from north-west India.

Varshney has recently commented on Sanaullah's interpretation of these analytical data on Taxila glasses and has made some interesting observations.[4] He is of the opinion that, contrary to the view of Sanaullah, the origin of Taxila glass was probably quite distinct from that of other antique glass such as Assyrian, Egyptian, Babylonian and Roman. According to him, with the exception of one isolated example of a Babylonian glass from Nippur, dating to about 250 B.C. and having a silica content of 71·14 per cent and a total acidic oxides content of 74 per cent, no single antique glass specimen compares favourably even with the three Taxila glasses (nos. 4, 7 and 10 of Table I) so far as the high silica content of about 71 to 72 per cent and the total acidic oxides content of over 74 per cent of the latter are concerned. These specimens have a high silica content and about 6 to 7·55 per cent of magnesia and lime, while the alkalis are about 17·5 per cent. Even the Nippur sample is distinctly of a different origin, as it has an alkali content of 12 per cent and lime and magnesia content of over 10 per cent. In view of these facts, the suggestion of Sanaullah that Assyrian recipes of glass-making were identical with the Indian ones cannot be maintained. It is, therefore, probable that the origin of Taxila glass was independent of Assyria. However, whether glass was an indigenous invention in India or its knowledge came to India from some other Middle Eastern country is more than can be said in the present state of our knowledge.

3. GLASS FROM NĀLANDĀ

Another site of great archaeological importance that has yielded a large number of glass specimens is Nālandā (District Patna), the most important centre of medieval

[1] Morey, *op. cit.*, p. 80.
[2] *An. Rep. Arch. Surv. Ind.*, 1919-20 (1922), p. 19; 1922-23 (1925), p. 157.
[3] Marshall, *Guide to Taxila* (1936), p. 59.
[4] Varshney in *Glass Industry*, Dec. 1950.

Mahāyāna Buddhism. A number of specimens of various colours from this site have been analysed, and the results are reproduced in Table II. Analyses of specimens 1 to 4 have already been published,[1] while the remaining two (5 and 6) have been recently analysed.

TABLE II

Specimens	1	2	3	4	5	6
SiO_2	62·61	61·21	70·74	61·50	63·44	56·72
Fe_2O_3	1·61	1·60	1·54	9·82	6·90	1·59
Al_2O_3	2·05	1·81	6·13			2·77
FeO	...	...	...	7·01	...	...
MnO	0·06	...	tr.	...	tr.	tr.
CuO	...	...	...	...	1·13	0·79
Cu_2O	0·57	0·75	...	0·49	...	...
CaO	6·95	8·15	2·11	5·20	8·00	11·95
MgO	4·17	3·83	0·26	0·06	4·14	3·17
Na_2O	17·85	18·25	15·80	15·92 by diff.	15·69	3·62
K_2O	5·04	4·98	2·94		1·54	0·49
CO_2	...	...	...	...	...	12·80
H_2O	...	...	...	...	...	7·16
TOTAL	100·91	100·58	99·52	100·00	100·84	101·06

Description of specimens

1. Light blue glass fragment.
2. Sky-blue glass fragments.
3. Green glass rectangular object.
4. Opaque beads of red glass.
5. Blue glass.
6. Decayed glass.

From the table it will be seen that specimens 3 and 4 have got a silica content of 70·74 per cent and 61·50 per cent respectively, and if the R_2O_3 oxides are taken with silica, the acidic oxides go up to 78·41 per cent and 78·33 per cent respectively. The alkalis range from 15·92 per cent to 23·23 per cent, but the lime and magnesia show a wide variation ranging from 2·37 per cent to 15·12 per cent. Specimens 1 and 2 are characterized by comparatively lower values for the acidic oxides, viz. 66·27 per cent and 64·62 per cent respectively. However, their lime and magnesia contents of 11·12 per cent and 11·98

[1] *An. Rep. Arch. Surv. Ind.*, 1922-23 (1925), p. 158 ; 1930-34, II (1936), p. 300.

per cent are much higher than those of specimens 3 and 4. The alkalis are also very high, viz. 22·89 per cent and 23·23 per cent. But they are very similar in composition to Taxila specimens 8 and 9 and are softer and less durable than specimens 3 and 4 (Table I). The opaque red beads (4), probably intended as imitation coral, are made of a variety of glass or paste which owes its colour to the presence of ferrous silicate and cuprous oxide. No such material has been discovered elsewhere in India so far. Specimen 6 is decayed glass. The loss on ignition, 12·80 per cent, has been found to correspond to the carbon dioxide given out by the specimen. The carbon dioxide present is equivalent to 21·13 per cent calcium carbonate and 6·63 per cent magnesium carbonate. This analysis shows that the prolonged burial of the specimen in the ground has resulted in the removal of alkalis and carbonation of lime and magnesia. The glass has evidently been attacked by carbonated water. The colouring matter of the glass is copper oxide.

All these specimens are free from lead and antimony. It is, therefore, clear that with the exception of the absence of these two elements, the recipes of glass-manufacture as used at Taxila did not undergo notable modifications down to the time of Nālandā.

4. GLASS FROM MISCELLANEOUS SITES

Some specimens of glass were discovered in 1938 in Dargai village in the Malākānd Agency (N.W.F.P., Pakistan), along with an earthen pot, probably employed for manufacturing glass. The age of these specimens is not known, but they show a striking similarity in chemical composition to Nālandā specimens 1 and 2 (Table II). The results of chemical analysis of two of these specimens are recorded in Table III, in which are also incorporated the analyses of several specimens from a number of other sites in upper India.[1]

TABLE III

Specimens	1	2	3	4	5	6	7
SiO_2	60·48	62·14	85·34	53·25	59·62	76·15	60·15
Fe_2O_3	2·60	1·26	1·72	9·16	3·21	6·33	1·49
Al_2O_3	2·92	2·61	3·88	6·12	3·42	1·97	10·26
MnO	tr.	tr.	...	...	...	...	...
Cu	...	...	...	9·13	...	...	...
CuO	0·68	...	2·53	...	...	...	1·33
CaO	8·67	8·71	2·74	9·18	7·55	4·58	3·27
MgO	2·57	2·97	2·59	1·47	2·03	tr.	2·83
Na_2O	19·94	20·09	} 1·20	11·69	4·10	10·97 by diff.	20·67 by diff.
K_2O	2·70	2·68	} by diff.	by diff.	19·00	...	...
TOTAL	100·6	100·46	100·00	100·00	98·93	100·00	100·00

Description of specimens

1. Blue glass from Dargai in Malākānd Agency.
2. Colourless glass from Dargai in Malākānd Agency.
3. Bluish green bangle, porous and partly decomposed, from Kurukshetra.
4. Small flat coral beads from Assam.
5. Black cylindrical weight of glass from Udaigiri, Gwalior.
6. Glass taurine model from Rairh, Jaipur.
7. Blue glass from flask, Taj Museum, Agra, late Mughul period.

[1]*An. Rep. Arch. Surv. Ind.*, 1922-23 (1925), pp. 157-58 ; 1924-25 (1927), p. 139.

The high proportion of alumina in the specimen from Agra (7) is significant. A certain amount of this ingredient no doubt facilitates the working of glass[1] and is a frequent constituent of glass, as it gives greater chemical durability, lower coefficient of expansion and greater freedom from devitrification, thus rendering it resistant to sudden changes in temperature. But the amount contained in the flask is excessive, as alumina above 4 per cent increases the viscosity of glass, making it difficult to melt and work. The specimen from Jaipur (6) is highly silicious containing relatively small amounts of lime, magnesia and alkalis.

5. GLASS FROM AHICHCHHATRĀ AND ARIKAMEḌU

Some specimens of glass were found at Ahichchhatrā in the course of excavation conducted there during 1940-44. This ancient site represents the capital of North Pañchāla (northern Gangā-Yamunā Doab) and was in occupation from the third century B.C. to the tenth-eleventh century A.D.[2] Two specimens (1-2) belonging to Stratum VI (first century) have been analysed and the results are recorded in Table IV. They show that the colour of the blue specimen (1) is due to copper oxide, and that of the green one (2) to the combined effect of copper and lead oxides. It is very probable that these substances are frits employed for glazing pottery.

Table IV also shows the results of chemical analysis of two specimens recovered from excavation at Arikameḍu[3] near Pondicherry.

TABLE IV

Specimens	1	2	3	4
SiO_2	61·49	59·56	73·62	72·49
Fe_2O_3	5·29	5·40	3·84	6·50
Al_2O_3	0·66	0·05	1·38	1·12
PbO	...	4·23	0·07	0·07
MnO	...	0·06	5·01	1·99
CuO	2·39	1·82	...	...
CaO	6·60	6·54	1·96	2·94
MgO	4·61	4·34	0·30	0·68
P_2O_5	1·94	1·36	...	...
Na_2O	15·32	14·19	1·30	0·20
K_2O	2·67	2·41	12·78	14·14
TOTAL	100·97	99·96	100·26	100·13

[1] Morey, *op. cit.*, p. 81.
[2] Ghosh in *Ancient India*, no. 1 (1946), pp. 37-40.
[3] Wheeler in *ibid.*, no. 2 (1946), pp. 96-97.

Description of specimens

1. Blue glass from Ahichchhatrā.
2. Green glass from Ahichchhatrā.
3. Deep violet glass from Arikameḍu.
4. Bluish violet glass from Arikameḍu.

Specimens 3 and 4 were recovered from unstratified deposits at Arikameḍu, a coastal centre of trade with the Roman world during the first-second centuries A.D. It is, therefore, of interest to examine whether they came from Rome or were of indigenous manufacture. The specimens were deeply coloured, unshaped, uncut lumps of clear glass and appeared to have undergone some decomposition on account of their prolonged burial in the soil. Examination has shown that both these specimens are potash glasses containing very little alumina and lime. The silica content is very high (73·62 to 72·49 per cent) and if the R_2O_3 oxides are taken together with silica, the acidic oxides go up to 80·11 to 78·84 per cent. The alkalis, mostly potash, account for 14·08 per cent to 14·34 per cent. Both these specimens, therefore, represent hard and durable glasses, showing little tendency towards devitrification. Large amounts of lime and alumina tend to cause devitrification of glass, but the amount of these components is low, a fact which explains their freedom from devitrification. The violet glass (3) is more or less transparent and contains a high proportion of manganese, which accounts for its deep violet colour. The bluish violet specimen is also a potash glass containing manganese as the colouring agent. This specimen was, however, very heterogeneous, and small bits of green glass could be easily picked out of the specimen. These glasses appear to be of indigenous manufacture, as no features connect them with the West.

A comparison of the chemical composition of these specimens with that of north Indian specimens shows that, with the exception of the specimen from Udaigiri (5, Table III), which is a potash glass, the latter are soda-lime glasses, whereas the Arikameḍu specimens are potash glasses. In this connexion it has to be considered that being near the sea it may have been convenient to use the wood ash (potash) for glass-making rather than to collect soda from the drier interior for the purpose.

6. CONCLUSION

From the analytical data on ancient Indian glasses recorded above it will be seen that barium has not been used at all, and the use of lead is attested by only two samples from Taxila and one from Ahichchhatrā. That lead was used in large quantities (24·5 per cent) in Chinese glass of the Han period (second century B.C.) has been shown by Beck and Seligman (above, p. 21). These workers have also reported the presence of 19·2 per cent of barium oxide in this specimen. Indian glass is, therefore, quite distinctive in this respect.

When the art of glass-blowing began to be practised in India is difficult to say, as most of the ancient specimens are fragmentary and some represent glass in the crude stage in the form of unshaped lumps. The beginning of the art of glass-blowing has been dated by Kisa to a little before the beginning of the Christian era,[1] and this view seems to be supported by the three sea-green flasks from Sirkap (above, p. 22). The excellent state of preservation of the flasks from Taxila further shows that they had been annealed

[1] Kisa, *op. cit.*, pp. 296-99.

after blowing. Glass tiles recovered from the Dharmarājikā Stūpa at Taxila (above, p. 22) also show that the art of moulding large glass objects had attained a high degree of perfection, and clear transparent glass could be manufactured on a large scale. As these large heavy tiles were free from devitrification and fracture, they also had probably been carefully annealed after moulding.

That the fabrication of glass vessels continued to be practised during later periods is proved by the discovery of an entire glass object of excellent workmanship during the excavations at Brāhmanābād (Sind),[1] where Cousens recovered 'a dainty little bowl of blue glass that seems to have been overlaid with white or cream enamel. But most of this has peeled off, the flaking and disintegrating surface showing these iridescent colours peculiar to mother-of-pearl.' From this description it appears that the iridescent effect was caused by the decomposition of glass and the so-called enamel may have been the product of chemical alteration. In view of the rarity of entire glass objects a sample of this glass was not available for chemical analysis.

It has recently been reported by Nagar[2] that Kopiā, a village about 30 miles from Basti (U.P.), marks an ancient centre of glass-manufacture. He has reported the discovery of a large number of tiny glass beads with very fine threading holes, a large variety of glass pendants, beads, bangles and lumps of glass. According to him, the beads are typologically similar to the beads etc. found by Peppé in the Buddhist stūpa at Piprāhwā,[3] 35 miles from Kopiā, and he has concluded that these glass specimens go back to the fifth century B.C. The author has recently inspected the site and collected, in addition to the types in Nagar's collection, a number of glazed sherds of different colours. An age-value should not be attached to these relics, of which the stratigraphical position is unknown, and a well-directed excavation of the site is necessary for a precise dating of these finds. The beads and glazed pottery collected by the author are under investigation, and the results are likely to contribute materially to our knowledge of the composition and properties of ancient glass and the technique of its manufacture. The discovery of glass of different colours and of glazed pottery of Kopiā type has recently been made by Banerji at Sayadpur Bhitari,[4] about 48 miles from Banaras, and the author is engaged in a study of these specimens with a view to correlating, if possible, the glass-industries of these two sites and establishing their chronology on internal evidence.

[1] *An. Rep. Arch. Surv. Ind.*, 1908-09 (1912), p. 82.
[2] Nagar in *Amrita Bazar Patrika*, 14th Aug., 1949.
[3] Peppé in *Jour. Royal Asiatic Soc.*, 1898, p. 573.
[4] Information from Mr. A. C. Banerji, Curator, Archaeological Museum at Sārnāth. Bhitari is a well-known ancient site with a pillar-inscription of the reign of Skanda-gupta of the fifth century A.D. : Fleet, *Corpus Inscriptionum Indicarum*, III (Calcutta, 1888), p. 52 ; also Führer, *The Monumental Antiquities and Inscriptions in the North-Western Provinces and Oudh* (1891), p. 228.

WOOD-REMAINS FROM ŚIŚUPĀLGARH

By K. A. Chowdhury *and* S. S. Ghosh

The Wood Technologist and Assistant Wood Technologist of the Forest Research Institute, Dehra Dun, well-known to the readers of Ancient India, *have once more earned the gratitude of the Department of Archaeology by undertaking the study of ancient wood-remains found in the Department's excavation at Śiśupālgarh, an interim report of which was published in no.* 5 *of this journal. The specimens have been found to belong to familiar varieties that even now grow in Orissa.*

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1. INTRODUCTION

THE excavation at Śiśupālgarh, near Bhuvaneswar in Orissa, was conducted by the Department of Archaeology in 1948 and 1950. An interim report of the first year's work has already been published,[1] and the periods of occupation have been dated as follows :

I (Early Period) : *circa* 300-200 B.C.
II A (Early Middle Period) : *circa* 200 B.C.-A.D. 100.
II B (Late Middle Period) : *circa* A.D. 100-200.
III (Late Period) : *circa* A.D. 200-350.

The wooden specimens collected in the excavation were later on sent to the Forest Research Institute, Dehra Dun, for examination. The results of this investigation are reported here.

2. MATERIAL AND METHOD OF STUDY

The material sent to the Forest Research Institute was packed in saw-dust soaked in water. All the timber specimens were dark in colour and their anatomical structure was not distinctly visible with a hand-lens. Superficial examination showed that the outer portion of almost all the material was softer than the inner. In fact, the outer portion came off in pieces under the pressure of fingers but the wood in the centre was quite intact. Since all the specimens were thoroughly soaked in water, they appeared to be heavy in weight, although a slight difference between the specimens was noticeable. Altogether five different lots of specimens were received, bearing the field-numbers SP II-412, SP II-413, SP II-422, SP II-432 and SP II-433 respectively.

[1] B. B. Lal, 'Śiśupālgarh 1948 : an early historical fort in eastern India', *Ancient India*, no. 5 (1949), pp. 62 ff.

Different laboratory methods were found necessary for the preparation of microscope slides from these materials. Specimens SP II-412, SP II-432 and SP II-433 were in a slightly better condition than specimens SP II-413 and SP II-422. The first lot was cut into small pieces and placed in vials with 70 per cent alcohol. Air was then driven out of these pieces with a vacuum pump. In order to remove the blackish colour from the specimens, they were transferred to ' Diaphanol ' and kept in a water-bath at 60° C. for two days. Then the wood-blocks were given several quick washes in 70 per cent alcohol. After that, they were passed through higher percentage of alcohol to absolute alcohol, then alcohol and ether, and embedded in 2, 4, 8, 16 and 25 per cent celloidin according to Lodewick's short method.[1] They were finally hardened in chloroform.

The second lot, when embedded according to the above method, did not give any good section for microscopic examination. A new laboratory technique had to be used, and it was found to be fairly successful. In this method the wood-blocks were kept in 5 per cent KOH in 50 per cent alcohol for twelve hours. They were then washed in hot water till all the traces of alkali were removed. The specimens were then treated with potassium hypochlorite and later again thoroughly washed. Finally they were embedded in celloidin.

Microtome sections cut were 15 microns thick. They were mostly stained with Heidenhains' haematoxylin and safranin and finally mounted in balsam. Some sections were also mounted without any staining.

3. RESULTS OF STUDY AND IDENTIFICATION OF MATERIAL

A. Specimen SP II-412 (pl. VII, 1 and 2)

It is a 25-in. long piece with a hollow centre and is somewhat twisted and knotty. It was collected from layer 19, belonging to the early level of Period II A.

Microscopic structure of the wood.[2]—*Growth rings* are visible, delimited by tangential bands of parenchyma cells. The rate of growth appears to be fast for the centre of the log. In one portion of the wood there is a slight tendency for ring porosity. This is due to somewhat concentric arrangement of the pores (pl. VII, 1). *Vessels* are small to large, mostly medium-sized. They are usually round and single, but occasionally some are found in radial pairs of 2-3. They are often filled with dark brown deposits. Inter-vessel pits are oval, medium-sized and fairly numerous. Tyloses are absent. *Fibres* are semi-libriform to libriform, round in cross-section and rather irregularly arranged. *Parenchyma cells* are paratracheal, terminal and diffuse. The paratracheal cells show variation from vasicentric to confluent structure. The terminals are in rows of 1-3 cells. The diffuse parenchyma cells are scanty (pl. VII, 1). *Rays* are 1-6 seriate (mostly 3-4) and homogeneous. The individual cells are round to oval (pl. VII, 2).

Identification.—*Acacia* spp. (*Leguminosae*, *Mimosoideae*).

B. Specimens SP II-413

These specimens, containing many pieces of wood, were recovered from layer 18, belonging to the middle level of Period II A. After microscopic examination, these pieces have been divided into three smaller groups (described below as A, B and C) and identified as different materials.

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[1] J. E. Lodewick, ' A shorter celloidin method ', *Science*, 60 (1924).

[2] The terminology of the descriptions is according to: Chalk in *Tropical Woods*, 55 (1938); Chattaway, *ibid.*, 29 (1932) ; Record and Chattaway, *ibid.*, 47 (1936) and 57 (1937).

(i). *Group A* (pl. VII, 3 and 4)

MICROSCOPIC STRUCTURE OF THE WOOD.—*Growth rings* are not very distinct. There are suggestions of some irregular concentric marks, but whether they are true growth marks or marks that have been produced later by severe twisting and compression which the timber underwent it is not possible to say with certainty (pl. VII, 3). *Vessels* are small, usually in radial pairs of 2-8 (mostly 2-3), uniformly distributed. In some places the pores appear to be arranged in radial chains, but it is doubtful whether this arrangement of pores was in the original wood or developed later. The authors are inclined to take the latter view. Inter-vessel pits are small, numerous and crowded. Tyloses are absent. *Fibres* are mostly unrecognizable due to bad preservation. They are non-septate and appear to be non-libriform. Inter-fibre pits are small and numerous. *Parenchyma cells* are mostly diffuse, occasionally in reticulum with the rays. They are better preserved than the fibres and appear to be fairly large in size (pl. VII, 3). *Rays* are distinct, 1-4 seriate and heterogeneous. They are of two types : (1) uniseriate are made up of exclusively high cells and (2) multi-seriate are with considerable variation in the percentage of high and low cells (pl. VII, 4).

IDENTIFICATION.—*Holarrhena antidysenterica*, Wall (*Apocynaceae*).

(ii). *Group B* (pl. VIII, 1 and 2)

MICROSCOPIC STRUCTURE OF THE WOOD.—*Growth rings* are fairly distinct in some places but not all over the wood. *Vessels* are fairly large, single or in pairs of 2-3, uniformly distributed. Tyloses are absent (pl. VIII, 1). Inter-vessel pits are large. *Fibres* are not clearly distinct in the cross-sections due to bad preservation. In some places they appear to be non-libriform and septate. *Parenchyma cells* are not easily distinguishable. *Rays* are of two types, (1) 2-3 seriate, not very deep, and (2) 4-6 seriate with *gum ducts* in the centre (pl. VIII, 2).

IDENTIFICATION.—*Boswellia serrata*, Roxb. (*Burseraceae*).

(iii). *Group C* (pl. VIII, 3)

Distribution of the vascular bundles in this specimen indicates its affinity to Monocotyledons. On further examination, it appears to be the stem of a bamboo. All attempts to match it with the important bamboos of India have failed. It is, therefore, identified as one of the bamboos.

C. SPECIMENS SP II-422 (pl. IX, 1 and 2)

The group bearing this number contained four pieces of wood, varying in length from 2 to 4 in. and ½ in. in diameter. These were obtained from layer 19 A, belonging to the early phase of Period II A.

MICROSCOPIC STRUCTURE OF THE WOOD.—*Growth rings* are fairly well-marked due to somewhat denser fibres in the extreme latewood. *Vessels* are single or in radial pairs of 2-3, uniformly distributed, fairly numerous. Vessel perforation is simple. Tyloses are absent. *Fibres* have mostly lost their shape due to deterioration. Where they are slightly better preserved, they appear to be semi-libriform and septate. *Parenchyma cells* are not very distinct. *Rays* are rather conspicuous on the tangential surface. They

are of two types. The uniseriate rays are made up of only high cells and show medium height. The multiseriate (up to 5 cells) rays have high cells at both ends and procumbent cells in the middle. Often both types join up and form very high rays (pl. IX, 2).

IDENTIFICATION.—*Casearia* spp. (*Samydaceae*).

D. SPECIMENS SP II-432 AND 433 (pl. IX, 3-5)

Specimen 432 is about 12 in. long, and 433 is 41 in. long with diameter at the bottom and the top 7 in. and 4 in. respectively (pl. IX, 3). The latter specimen was found in the layer associated with the first occupation-level of the clay rampart (Period II A). Both the specimens are described here together, since they show the same anatomical structure.

MICROSCOPIC STRUCTURE OF THE WOOD.—*Growth rings* are distinct due to concentric parenchyma bands. Some are so unequally spaced that it is doubtful whether all are really true growth rings (pl. IX, 4). *Vessels* are small to medium-sized, single or in pairs of 2-3, uniformly distributed. They contain dark gummy deposits but no tyloses. Inter-vessel pits are minute and crowded, often coalescing. *Fibres* are fairly distinct, thick-walled, well-packed and occasionally filled with gummy deposits. *Rays* are uniseriate to multiseriate (up to 7 cells), full of gummy deposits. The end cells often contain crystals (pl. IX, 5). Vertical *gum ducts* have been observed in one place. They are fairly large, in concentric rows, surrounded by parenchyma cells, showing up like growth marks.

IDENTIFICATION.—*Soymida febrifuga*, A. Juss. (*Meliaceae*).

4. GENERAL REMARKS

Altogether remains of five different woods and one bamboo have been determined. Of these, three timbers have been specifically identified, namely, *Holarrhena antidysenterica* Wall., *Boswellia serrata* Roxb. and *Soymida febrifuga* A. Juss.[1] Amongst the rest one specimen has been traced down to *Acacia* spp. The genus *Acacia* contains over 400 species, distributed over the tropics and subtropics of the Old and the New World. In India about twenty species are found[2] and they are widely scattered throughout the country. At present in Orissa alone sixteen species have been recorded. In view of this, it is not possible to say definitely to which Indian species the timber obtained from Śiśupālgarh belongs.

Another specimen has been found to be *Casearia* spp. This genus is confined to the warmer parts of the world. In India there are about eight species, of which two are found in Orissa. The timbers of these species are so similar that it is not possible to separate them. Lastly, one specimen has been identified as bamboo, but, as has been said above (p. 30), our repeated attempts to match it with the well-known bamboos have failed, though there is little doubt about the identification.

All the six specimens are found now in the forests of Orissa. In fact, most of them are noticed in the forest near about Śiśupālgarh. It will, therefore, be seen that this find does not throw any light on the commercial connexion of Śiśupālgarh with other countries—far and near. Furthermore, from a study of these wood-remains, one is inclined to conclude that there has been little change in the climatic conditions of this locality during the last two thousand years.

[1] R. S. Pearson and H. P. Brown, *Commercial Timbers of India* (1932).

[2] *Ibid.*; Gamble, *op. cit.*

5. SUMMARY

1. Some remains of wood collected during the archaeological excavation at Śiśupālgarh, Orissa, in 1948, have been microscopically examined.

2. The age of the site is said to be 300 B.C. to A.D. 350.

3. Altogether six different specimens have been identified. They are *Acacia* spp., *Holarrhena antidysenterica* Wall., *Boswellia serrata* Roxb., one bamboo, *Casearia* spp. and *Soymida febrifuga* A. Juss.

4. As all these species of trees are now found in the forests of Orissa, no climatic change in the region during the last two thousand years is indicated.

6. ACKNOWLEDGEMENT

Grateful acknowledgements are due to the Director General of Archaeology in India for giving us an opportunity to study this material.

EXPLANATION OF PLATES

Plate VII

Acacia spp.

1. SP II-412 : cross-section showing general structure of the wood. (×10.)
2. SP II-412 : tangential section showing distribution of rays ; note arrangement of cells in them. (×30.)

Holarrhena antidysenterica, Wall.

3. SP II-413(a) : cross-section showing general structure of the wood ; note distortion of vessel elements. (×10.)
4. SP II-413(a) : tangential section showing distribution and structure of rays. (×50.)

Plate VIII

Boswellia serrata, Roxb.

1. SP II-413(b) : cross-section showing general anatomy ; note distortion of the wood. (×10.)
2. SP II-413(b) : tangential section ; note horizontal gum ducts in some rays. (×50.)

Bamboo

3. SP II-413(c) : cross-section showing distribution of vascular bundles and the monocotyledonous origin of the specimen. (×10.)

Plate IX

Casearia spp.

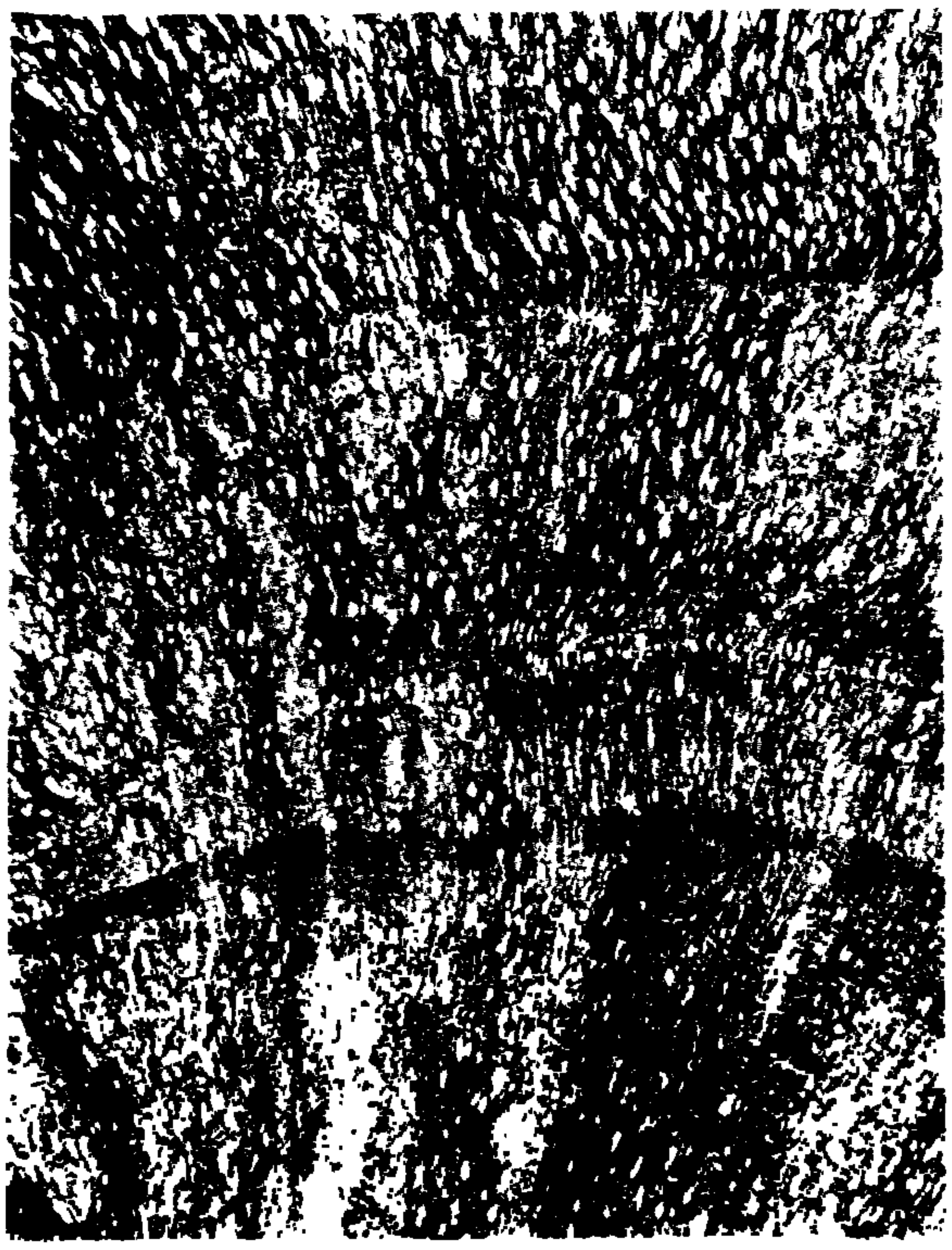
1. SP II-422 : cross-section showing general structure of the wood. (×10.)
2. SP II-422 : tangential section ; note height of the rays. (×50.)

Soymida febrifuga, A. Juss

3. SP II-433 : a photograph of the specimen. It is 41 in. in length and has a diameter of 4 in. at the top and 7 in. at the bottom.
4. SP II-433 : cross-section showing general structure of the wood ; note distribution of concentric parenchyma bands. (×10.)
5. SP II-433 : tangential section ; note structure of the rays and gummy deposits in different cells. (×50.)

1

2



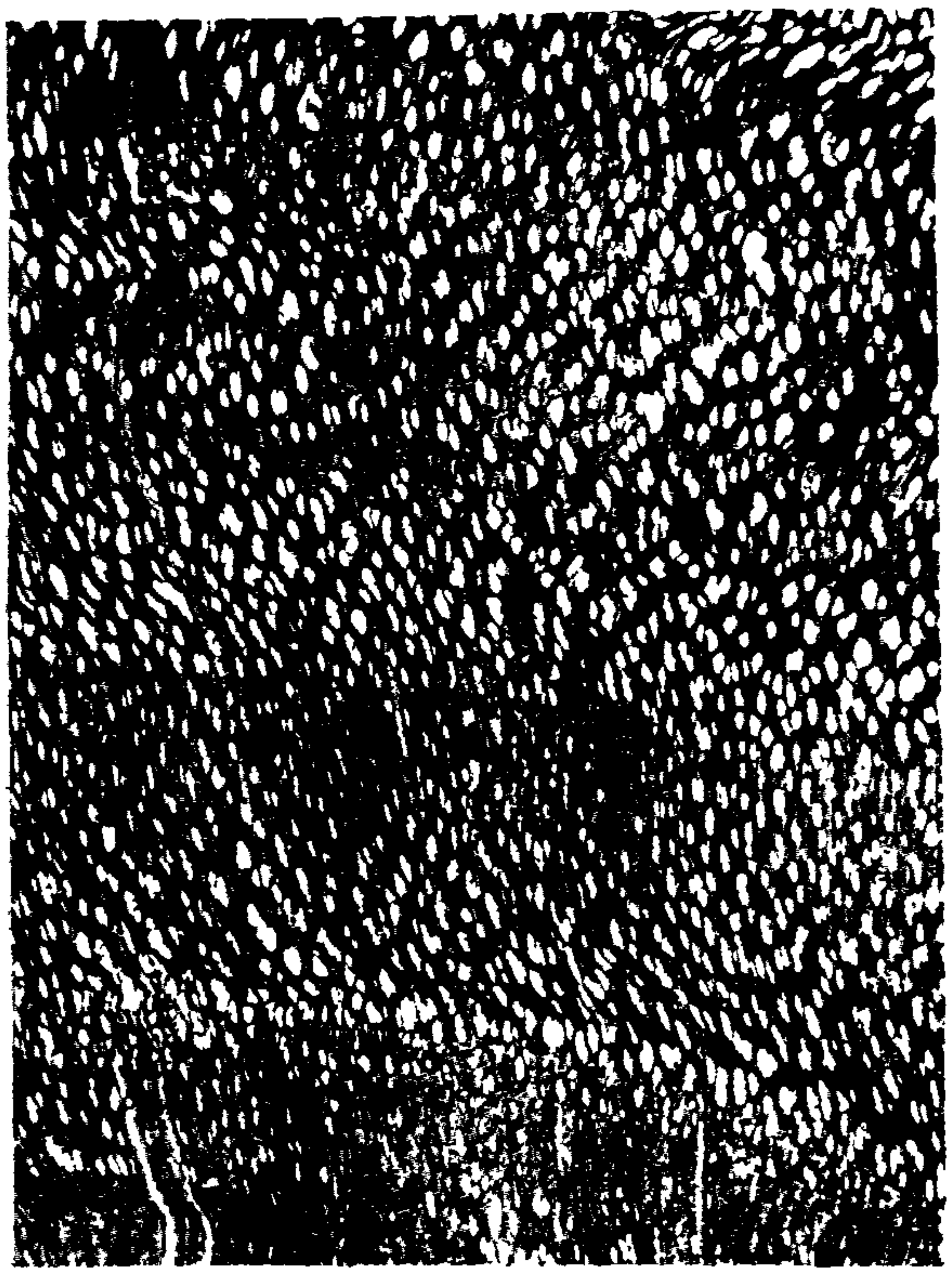
3

4

Wood from Śiśupālgarh : 1 *and* 2, Acacia *spp.;* 3 *and* 4, Holarrhena antidysenterica *Wall*

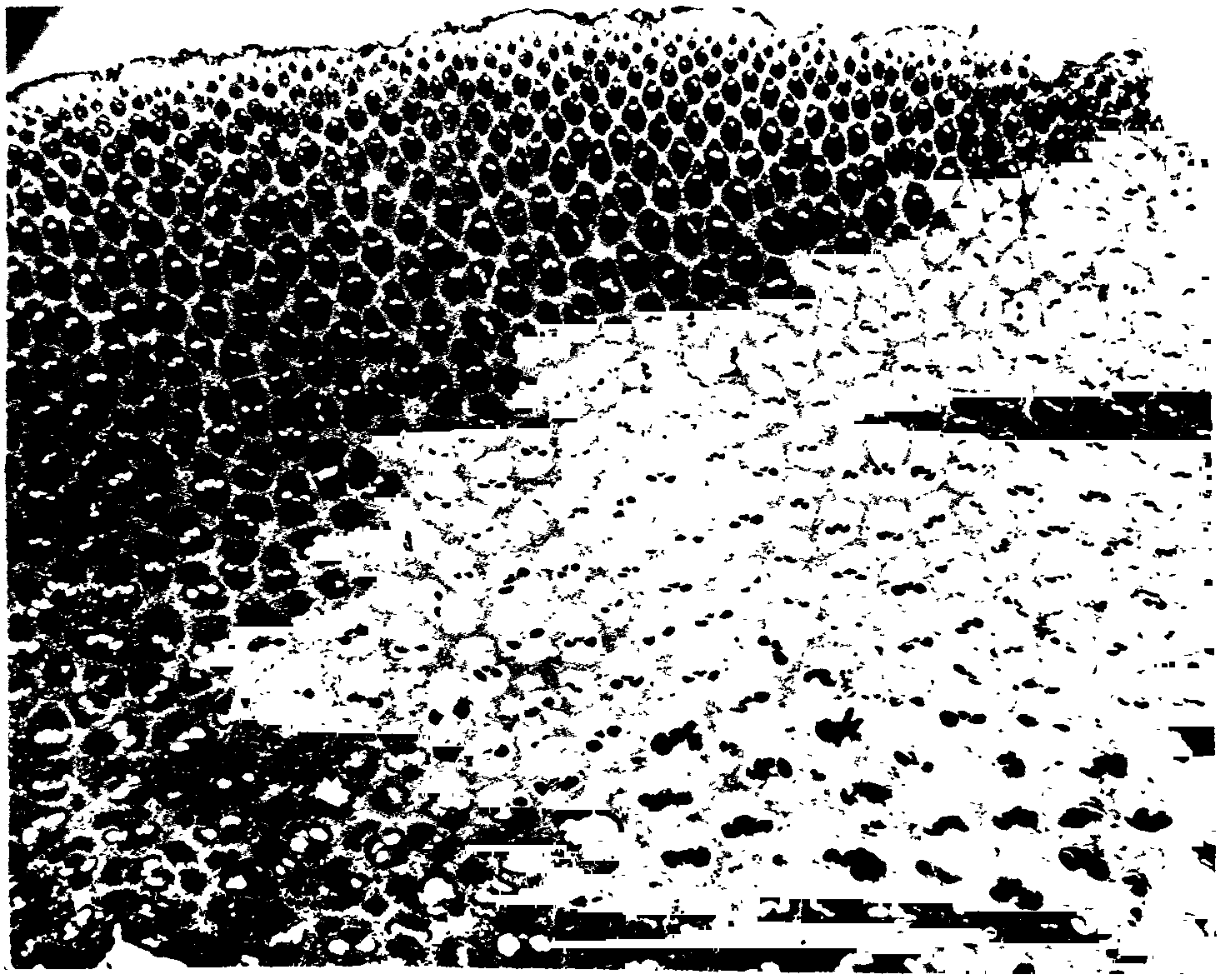
(*see page* 32)

To face plate IX



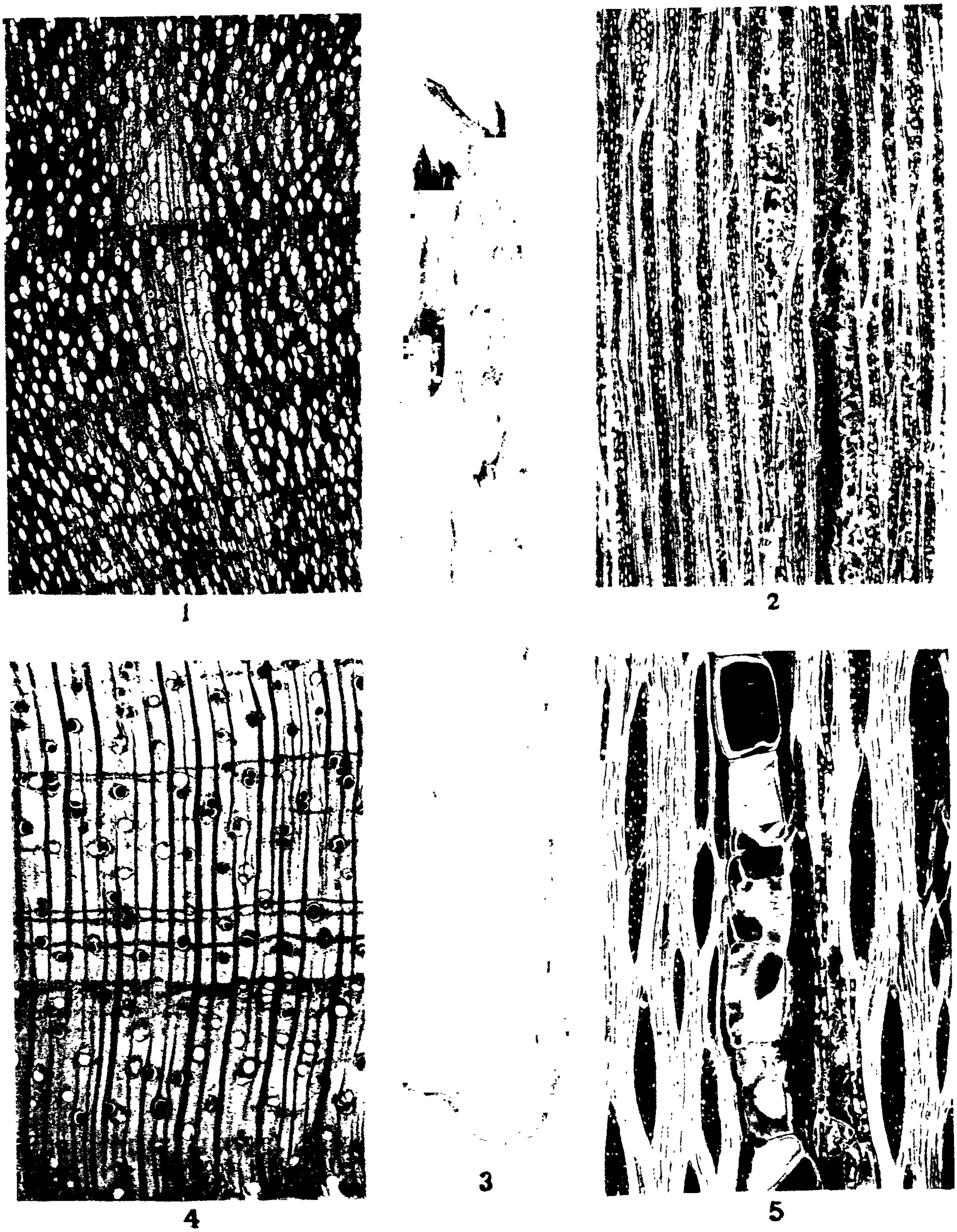
1

2



3

1 *and* 2, Boswellia serrata *Roxb.*; 3, *bamboo* (*see page* 32)



1 *and* 2, Casearia *spp.:* 3-5 Soymida febrifuga *A. Juss* (*see page* 32)

BEADS FROM AHICHCHHATRĀ, U.P.

By Moreshwar G. Dikshit

The value of beads as a dating factor has not yet been extensively tested in the historical archaeology of India, a chief reason being the limited amount of stratified material and the absence of well-documented reports thereon. In recent years, however, attention has been directed to this field of investigation, and the researches of Dr. M. G. Dikshit, Lecturer in Archaeology, University of Saugor, who has systematically studied the bead-material from many excavated sites and in museums, deserve mention in this connexion. In the present article he deals with the beads found in the 1940-44 *excavations at Ahichchhatrā, the pottery and terracotta figurines of which have been published in the previous numbers of this journal.*

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1. INTRODUCTION

THE Archaeological Survey of India conducted extensive excavations at Ahichchhatrā, District Bareli, U.P., and the readers of *Ancient India* are already familiar with the principal pottery-types[1] and terracotta figurines[2] unearthed there. In 1951 the beads from the site were sent to me for study and report by Shri A. Ghosh, to whom my thanks are due.

The method of recording followed at Ahichchhatrā and the chronology of the site have already been dealt with in the two previous articles. As in the case of terracottas, the bead-material from the plot called AC III, which yielded the most representative strata representing the different periods in the history of the site, has been taken here as the basis for study, the beads from other plots and from the surface being utilized for comparative typological analysis.

The chronology of the site may be repeated here :

Stratum IX : before 300 B.C.
Stratum VIII : 300 to 200 B.C.
Stratum VII : 200 to 100 B.C.
Strata VI and V : 100 B.C. to A.D. 100.
Stratum IV : A.D. 100 to 350.
Stratum III : A.D. 350 to 750.
Stratum II : A.D. 750 to 850.
Stratum I : A.D. 850 to 1100.

2. ETCHED BEADS

Amongst the distinctive types of beads, the etched variety naturally deserves special attention. These beads, having decorative patterns etched on their surfaces by a chemical process, were known in India from a very remote antiquity, the earliest specimens being those from the Harappan sites. The nature and the distribution of these beads in India have been exhaustively dealt with in my monograph on etched beads in India.[3] At Ahichchhatrā, as many as ten beads of carnelian and agate were recovered from the excavations, and there are three more in a string of sixtyseven beads collected from the surface. With the exception of one bead, no. 10, which belongs to Type II, all are of Type I, in which the patterns are etched in white directly on the surface of the stone. Most of the patterns by themselves do not show any new variety, having been included in the monograph referred to above. The majority of the specimens was recovered from areas other than AC III and therefore cannot be very accurately dated. The following list shows their distribution and the antiquity of certain patterns illustrated by them is discussed below.

TYPE I, NOS. 1-9 (fig. 1 ; pl. X)

Carnelian

1. Short cylinder circular with zonal bands.
No. 4075. AC III, KIX/E5g, -38 ft. Stratum I.

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[1] A. Ghosh and K. C. Panigrahi, 'The pottery of Ahichchhatra', *Ancient India*, no. 1 (1946), pp. 37 ff.

[2] V. S. Agrawala, 'Terracotta figurines of Ahichchhatrā, *ibid.*, no. 4 (1947-48), pp. 104 ff.

[3] M. G. Dikshit, *Etched Beads in India*, Deccan College Monograph Series, no. 4 (Poona, 1949).

2. Convex barrel circular. Zonal bands and three eyes formed by circles.
No. 1411. AC III, KX/F2b, -34 ft. Stratum I.

3. Long barrel circular, decorated with eyes in compartments. Variant of pattern 6b in *Etched Beads*, pl. V.
No. 3164. AC V, QVIII/P4h, -63 ft.

4. Long barrel circular, decorated with convex lines and rows of four short strokes between each. New pattern.
No. 3059. AC V, QVIII/O9j, -50½ ft.

Agate

5. Spherical, decorated with pattern 6a.
No. 8902. AC III, KIX/K10k, -60 ft. Stratum VIII.

6. Spherical, decorated with pattern 6a.
No. 8524. AC III, KIX/P5c, -49 ft. Stratum IV*b*.

7. Spherical, decorated with pattern 6a.
No. 6554. AC IV, MIX/N4k, -43 ft.

8. Long barrel circular, decorated with pattern 14.
No. 6554. AC V, QVIII/P5r, -73 ft.

9. Spherical, decorated with zigzag lines between zonal bands.
Surface.

TYPE II, NO. 10 (fig. 1 ; pl. X)

Carnelian

10. Long barrel circular, having diamonds with zonal bands. New pattern similar to pattern 20.
No. 3066. AC V, QVIII/P10j, -60 ft.

A few of the patterns decorating these beads are interesting. The carnelian bead no. 4, with horizontally laid convex lines and having four strokes in each compartment, is unfortunately not very accurately dated but is believed to be very early. This pattern occurs amongst the beads from Kauśāmbī,[1] where it is dated about 200 B.C.

No. 5 above (spherical bead with pentagons, pattern 6a) indicates that the antiquity of this pattern can be carried back to about 300 B.C. The pattern, which is noticed for the first time at Taxila, had a very wide distribution in the Gangetic valley but seems to have reached the south only in the early centuries of the Christian era, as can be inferred from the stratified beads from the excavations at Nāsik, Tripurī, Bahal and Koṇḍāpur. In the present state of our knowledge it seems likely that it might have found its way into the Deccan with the advent of the Śātavāhanas.

Pattern 14, which is noticed on no. 8, is a variation of pattern 6a, the difference being only in the shape, which is long barrel circular. This pattern shares the same chronological features as pattern 6a, though a slightly higher antiquity (400 B.C.) is claimed by the excavated beads from Kauśāmbi. The barrel shape is more recurrent than the spherical.

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[1] Information from Shri G. R. Sharma.

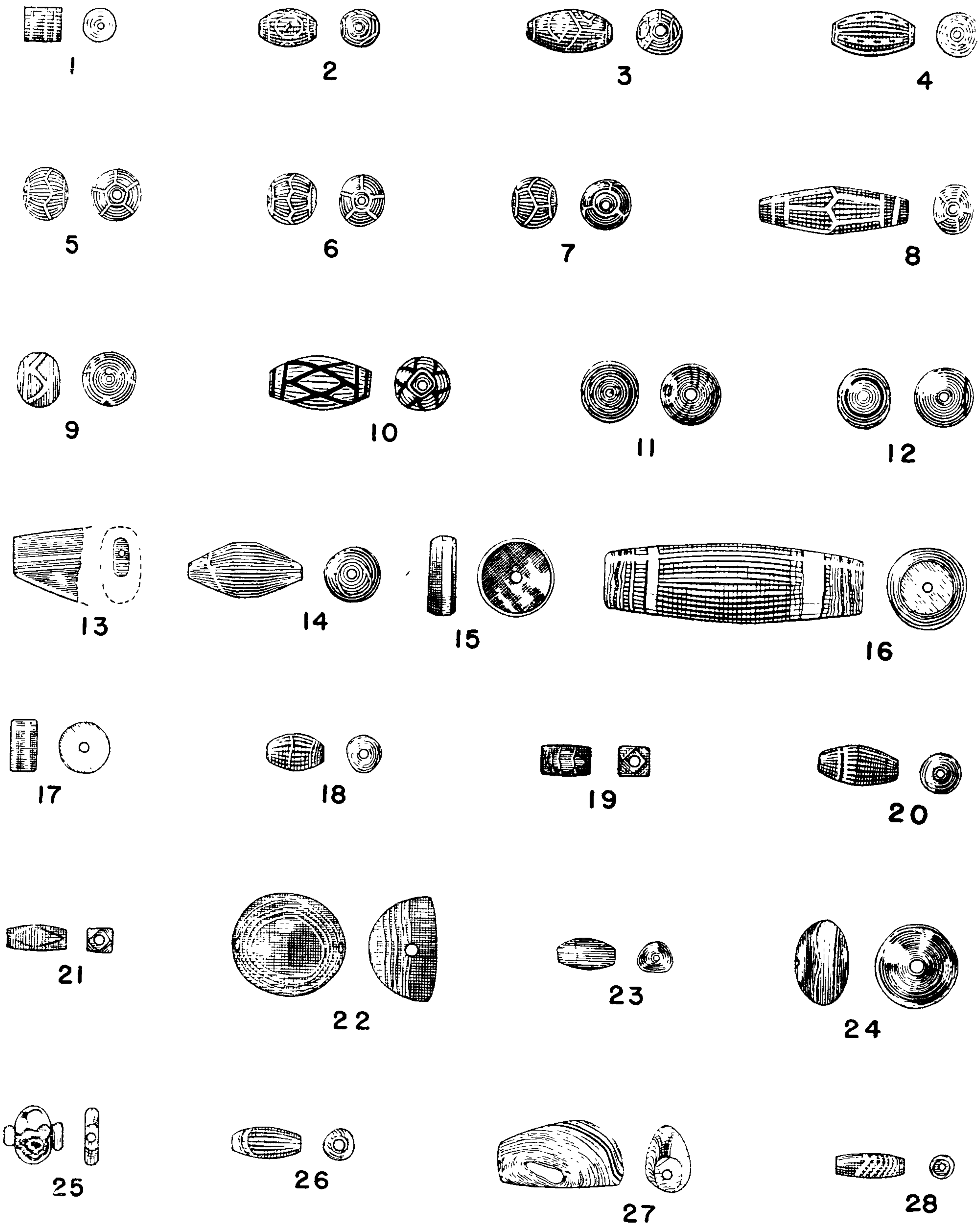

FIG. 1. 1-4 *and* 10, *etched carnelian* ; 5-9, *etched agate* ; 11-28, *agate*. $\frac{1}{1}$

A somewhat rare pattern is revealed by bead no. 3, which is decorated with three small eyes, probably intended as protection against the 'evil eye'. The decoration is very truthful ; the corners of the eyes are indicated and the central dot represents the corona. I have seen similar beads from Kauśāmbī in the B. M. Vyas collection at Allahabad, but in these the 'eyes' assume the shape of elongated circles occasionally without the central dot. An identical bead, also from Kauśāmbī, is in the author's collection.

3. BEADS OF AGATE

Amongst the stone beads, agate and carnelian ones constitute the largest number, there being eightyeight beads of agate and sixtythree of carnelian. A large majority of the former is banded and shows a very careful selection of the material. The following shapes are represented : spherical, 19 ; long barrel circular, 16 ; short barrel circular, 4 ; long barrel triangular, 1 ; short cylinder circular, 1 ; convex barrel lenticular with lug-collars, 1 ; rectangular cornerless square, 27 ; trapezoid or tapering lenticular, 1 ; plano-convex elliptical, 1 ; and leech-shaped lenticular, 1.

The spherical beads are distributed over all the strata, with their dates ranging from 300 B.C. to A.D. 1100, but only a few amongst them are remarkable for the excellent polish they bear. No. 11 is an eye-bead having a number of stratified eyes in the natural stone and is very carefully polished. It is datable to about 300-200 B.C. No. 12, of the same period, is remarkable for its elegant polish.

The long barrel circular beads are mostly confined to Strata IV and III, though quite a large number are either unstratified or surface-finds. An unusually large bead, no. 16, though not very remarkable for its workmanship, is paralleled by similar beads from Kauśāmbī, Taxila and Valabhī.[1] It is dated about A.D. 350. Nos. 20 and 26 have been selected on account of their very high polish showing excellent workmanship of the lapidaries at Ahichchhatrā, though their dates are not very clearly defined.

Short barrel circular is the shape of four beads, two of which, nos. 15 and 24, are illustrated here. In shaping these, the flattened surfaces have been so cut as to leave the natural bands in the centre. All these are perforated by a single operation from end to end and thus indicate that the drill used for them was sufficiently long ; in the case of all other beads the usual practice was to drill them from opposite ends and to allow the bores to meet. These, if not properly worked, result in the perforation having an obtuse angle or even a V-shape. The ancient practice of boring in this manner is continued by the lapidaries even now in the modern bead-industry at Cambay ; and in spite of the better equipment they prefer to drill the bead by the double-perforation method for fear of breaking the bead at one of the lateral ends. A short cylinder bead, no. 17, shows a small fracture near the hole resulting out of the pressure exerted by the drill.

Amongst the faceted forms only a few beads are noteworthy. A long barrel triangular bead, no. 23, is not very accurately dated, but from its worn-out condition it appears to have been an old specimen. The antiquity of this shape is established by carnelian and agate beads at Taxila[2] datable to about the first century A.D. At Kauśāmbī a similar carnelian bead was found in a stratum attributed to the same century. At Tripurī identical beads occur in the second century levels. At Bahal[3] two beads of this shape are dated about the first century, which is also the date of two carnelian beads from Nāsik. Agate beads from

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[1] Author's collection.

[2] H. C. Beck, *Beads from Taxila*, Mem. Arch. Surv. Ind., no. 65 (Delhi, 1941), pl. I, 1, 18 etc.

[3] Information from Shri M. N. Deshpande (for this and subsequent references to Bahal).

Koṇḍāpur[1] are of the Śātavāhana period, while the megalithic burials at Raigir[2] contained six specimens in quartz and one of jasper. Surface-collections made at Arikameḍu[3] show that the type also existed there, though accurate dating is not possible. The barrel triangular bead seems, therefore, to have had a very wide distribution round about the early centuries of the Christian era both in north and south India.

Outside India, beads of this shape occur amongst some of the oldest civilizations of the Ancient World, extant specimens being known from the Tasian Culture in Egypt (limestone),[4] at Ur and Kish in Iraq (quartz) and in Crete (amethyst).

A very interesting panel bead, no. 13, from Stratum VI has the shape of a trapezium and is lenticular in section. The natural bands in the stone run transversely on the flat sides. It is partly broken but must have been very beautiful when complete. I have not seen any bead of this shape.

Twentyseven beads are rectangular in shape with a square section. These have their corners chamferred in such a way as leave a diamond-shaped panel on the elongated faces. These beads, all banded, come from a very late stratum (Stratum I). This shape is very common amongst the trade-beads used to the present day and can be purchased in quantities in the market. Before the last War Germany used to export identical beads made of a synthetic material exactly resembling banded agate. The specific gravity of these, however, was much lower than real agate. The specimens from Ahichchhatrā are no doubt of genuine banded agate, but their late date precludes the possibility of using them as guide-types. The first of the two beads in the collection, nos. 19 and 21, is from Stratum I, and the second from Stratum II.

Another interesting bead, no. 22, is a plano-convex bead having the appearance of a seal-stamp. It has an oval base and a natural ' eye ' of two rings in the rounded portion at the top. Beads of this shape are known to me from the surface-collections at Kauśāmbī[5] and Rājghāṭ.[6] The specimen from Ahichchhatrā belongs to Stratum II.

The unstratified collection includes a tiny barrel lenticular bead with lug-collars (no. 25). The importance of this shape and its value for the purpose of dating has already been dealt with elsewhere.[7] The present bead is of veined agate and is very well made.

The collection also includes a very fine leech-shaped bead (no. 27), which, though not accurately dated, appears to be a very early specimen. One of its ends is unfortunately broken, but the bands interchanging between black and white produce a very artistic effect.

Leech-shaped beads have a very remote antiquity in India. The earliest specimen is a single agate bead from Harappā.[8] At Taxila[9] these occur in the Mauryan strata in Bhīr Mound, and a few from Sirkap evidently show the continuance of the shape till the early centuries of the Christian era. These are fairly well-distributed in the Gangetic

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[1] M. G. Dikshit, *Some Beads from Kondapur*, Hyderabad Arch. Series, no. 16 (Hyderabad, 1952), pl. I, 3.

[2] *Man*, special India number, XXX, no. 10 (October 1930).

[3] Beads in the Bibliothèque at Pondicherry (for this and subsequent references to Arikameḍu, unless otherwise specified).

[4] Brunton, *Mostgedda and the Tasian Culture* (London, 1937), pls. XIII, 18 ; XXII, 27.

[5] Beads in the Allahabad Municipal Museum (for this and subsequent references to Kauśāmbī unless otherwise specified).

[6] Beads in the Bhārat Kalā Bhavan, Banaras (for this and subsequent references to Rājghāṭ).

[7] *Ancient India*, no. 2 (1946), p. 97 ; H. D. Sankalia and M. G. Dikshit, *Excavations at Brahmapuri (Kolhapur)* 1945-46 (Poona, 1952), pp. 102, 144 etc.

[8] M. S. Vats, *Excavations at Harappā*, II (Delhi, 1940), pl. CXXXIX, 1.

[9] Beck, *op. cit.*, pl. III, 1-6 and 37 ; IV, 8, 9 and 35.

valley, several specimens being known from Rājghāṭ, Masaon Dīh,[1] Madhuri,[2] Ghosi[3] and from the excavations at Kauśāmbī. At Vaiśālī[4] they occur exclusively in the Mauryan stratum, and probably this is also the date of several exquisite specimens preserved in the Patna Museum, found during the sewage operations. In south Bihar eight carnelian beads and a single one of agate were recovered by Col. D. H. Gordon from a site called Haribāṛā on the banks of the Karkai river.[5] None, however, seems to have been reported from south India.

Outside India, leech-shaped beads are known from Babylon,[6] Ur and Kish in Iraq,[7] at Hissar in Damghan[8] and amongst the XIIth Dynasty beads in Egypt.[9]

From the antiquity of the shape as known from the Harappan example, Marshall thinks that they may be of Indian origin or the technique may have been evolved at different centres from a common source.[10]

This specimen, together with another specimen in carnelian, no. 42, is unfortunately not clearly stratified.

Nos. 11-28 (fig. 1 ; pl. X)

11. Spherical eye-bead.
No. 9000. AC III, KIX/P1od, -60½ ft. Stratum VIII.

12. Spherical eye-bead.
No. 8999. AC III, KX/L1d, -60½ ft. Stratum VIII.

13. Tapering lenticular.
No. 8808. AC III, KX/L2d, -58 ft. Stratum VI.

14. Long barrel circular.
No. 8746. AC III, KX/L2c, -52 ft. Stratum V.

15. Short barrel circular.
No. 8763. AC III, KX/L1c, -50 ft. Stratum IV*c*.

16. Long barrel circular.
No. 8534. AC III, KX/F1j, -47½ ft. Stratum III*d*.

17. Short cylinder circular.
No. 6436. AC III, KX/F2h, -45 ft. Stratum III*b*.

18. Long barrel circular.
No. 4214. AC III, KIX/K5e, -41 ft. Stratum I.

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[1] Author's collection (for this and subsequent references to Masaon Dīh).
[2] Author's collection (for this and subsequent references to Madhuri).
[3] Beads in the collection of Shri Shri Nath Saha, Banaras (for this and subsequent references to Ghosi).
[4] Information from Shri Krishna Deva (for this and subsequent references to Vaiśālī).
[5] Notes on the Gordon collection, kindly supplied by Col. D. H. Gordon.
[6] R. Koldeway, *Excavations at Babylon* (translated, 1914), p. 263, fig. 185.
[7] C. L. Wooley, *Ur, the Royal Cemetery* (Oxford, 1934) p. 372, fig. 79 ; pl. 132, U12474.
[8] E. Schmidt, *Excavations at Tepe Hissar, Damghan* (Philadelphia, 1937), pls. XXXV ; LXVI, H. 321.
[9] Cf. Dorothy Mackay in *Antiquity*, no. 72 (Dec. 1944), p. 204.
[10] J. Marshall, *Taxila*, II (Cambridge, 1952), p. 744.

19. Rectangular cornerless.
No. 1173. AC III, KX/F2g, -41 ft. Stratum I.

20. Long barrel circular.
No. 3833. AC III, KIX/C10g, -41 ft. Stratum I.

21. Rectangular cornerless.
No. 4122. AC III, KIX/E8f, -40 ft. Stratum II.

22. Circular plano-convex.
No. 4045. AC III, KX/A2c, -39 ft. Stratum II.

23. Long barrel roughly triangular.
No. 4098. AC III, KIX/E6f, -38 ft. Stratum I.

24. Short barrel circular.
No. 340. AC III, KX/B8g, -33 ft. Stratum I.

25. Standard barrel lug-collared tabular.
No. 3111. AC V, QVIII/P3j, -50 ft.

26. Long barrel circular.
No. 9314. AC VII, HV/C6f, -42 ft.

27. Leech-shaped oval.
No. 11407. AC XV, RVII/T10h, -60½ ft. (Pit).

28. Long barrel circular.
No. 11309. AC XV, RVII/T9j, -52 ft.

4. BEADS OF CARNELIAN

The total number of carnelian beads excavated at Ahichchhatrā is sixtythree. The most popular shapes are the spherical and long barrel circular, of which there are twentytwo and twelve specimens respectively. The stratified spherical beads occur between Strata IV and I, i.e. about A.D. 100 and 1100. There is a striking predilection for short barrel circular beads in Stratum VIII, while the long barrel circular ones are confined to Stratum I only. Besides these the following shapes are represented : multi-faceted bicone twisted pentagonal, 4 ; barrel-shaped hexagonal, 3 ; truncated bicone hexagonal, 2 ; long barrel square, 2 ; standard barrel triangular, 1 ; circular tabular, 1 ; hexagonal tabular, 1 ; diamond tabular, 1 ; rectangular hexagonal flattened, 1 ; leech-shaped lenticular, 1 ; and dagger-shaped pendant, 1.

The multi-faceted twisted pentagonal bead is a very common shape on several sites in India, but I have rarely seen this shape represented by any material other than chalcedonic quartz and faïence. It is a particularly common shape for green jasper beads. At Ahichchhatrā the date of the four beads ranges between Strata IV and I. Many beads from Kauśāmbī, Rājghāṭ and Ghosi are unstratified. At Taxila the period for these beads ranges between the first century B.C. and the first century A.D. At Tripurī these occur in Stratum IV (A.D. 100-200). At Nāsik, Bahal and Kolhāpur[1] they are found in the Śātavāhana stratum.

[1] Sankalia and Dikshit, *op. cit.*, p. 95, figs. 30, 3 and 31, 9.

PLATE X

Beads from Ahichchhatrā: 1-4 *and* 10, *etched carnelian:* 6-9, *etched agate:* 11-28, *agate*
5, *etched agate, not illustrated*

29-50, *carnelian;* 51-58, *chalcedony*

The long barrels and truncated bicones, both with hexagonal sections, nos. 36, 38, 35 and 40, are shapes of such common occurrence and are distributed over such a wide span of time that by themselves they have little dating value. The present specimens are from Strata I and II and are therefore comparatively recent.

A long barrel-shaped bead square in section, no. 41, is a somewhat rare form. This bead is very well made but was found near the surface. Carnelian beads of this shape are very frequent in Mandla District, Madhya Pradesh, a large number from Hirdaynagar being preserved in the Central Museum, Nagpur.

A small barrel-shaped bead triangular in section, no. 50, is a very interesting specimen. Though not accurately stratified, the bead-form has a dating value, as already discussed (above, p. 38).

A circular tabular bead, no. 45, presents another common shape and appears to be a very old specimen. At Taxila[1] the earliest bead of this shape and material is dated to the first century B.C. Identical beads are quite common among the Śātavāhana sites in the Deccan and the megalithic burials in south India.

A hexagonal tabular bead, no. 47, has a rare shape but is unstratified. Identical beads are known to me from Kauśāmbī, Rājghāṭ and Arikameḍu, but these are similarly unstratified. Diamond-shaped tabular beads, e.g. no. 44, are similarly scarce.

The rectangular hexagonal bead, no. 43, is a rare specimen. The probable date of this bead, which emanates from Stratum IX, is earlier than 300 B.C. Beck has commented upon the prevalence of flattened shapes of beads in ancient India.[2]

Leech-shaped beads of carnelian, e.g. no. 42, are very scarce and the antiquity of this type has already been discussed (above, p. 39).

Of special interest is a small well-made pendant, no. 48, shaped in the form of a dagger. The shape has a remote antiquity in India. At Taxila[3] two dagger-shaped pendants, of carnelian and agate, both of them datable to the third century B.C., were found. In the excavation at Vaiśālī several pendants of this shape were found in the Mauryan stratum. Two similar pendants, one of ivory and the other of crystal, both from Kauśāmbī, are preserved in the Vyas Collection in the Allahabad Municipal Museum. In the south these are somewhat rare, two (one lapis lazuli and another faïence) being known from Konḍāpur.[4] At Nāsik a dagger-shaped pendant of glass, having a lion's head at the top, was found associated with the Śātavāhana stratum. A small crystal dagger pendant from Arikameḍu is preserved in the Madras Museum, and there are a few from Maski as well.[5] In the modern bead industry at Cambay dagger-shaped pendants of carnelian are frequently made for export to Assam. These pendants are described by them as 'tiger-claws' from the curved shape. It is often very difficult to distinguish between the various forms ; but the decoration of necks by tiger-claws had a long history in India, as Bāṇa (seventh century) mentions them in his *Harsha-charita*[6] and *Kādambarī*.[7]

Nos. 29-50 (fig. 2 ; pl. XI)

29. Short barrel circular.
No. 10877. AC III, KIX/P9b, -62 ft. Stratum VIII.

30. Short barrel circular.
No. 8889. AC III, KIX/P9a, -61 ft. Stratum VIII.

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[1] Beck, *op. cit.*, pl. IV, 38.
[2] *Ibid.*, p. 8.
[3] *Ibid.*, p. 31.
[4] Dikshit, *Some Beads from Kondapur*, pl. II, 103 and 104.
[5] *An. Rep. Arch. Deptt. H. E. H. Nizam's Dominions*, 1935-36 (Calcutta, 1938), pl. VI B.
[6] *Harsha-charita*, Nirṇayasāgara Press ed. (Bombay, 1912), p. 134.
[7] *Kādambarī*, ed. M. R. Kale (Bombay, 1896), p. 54.

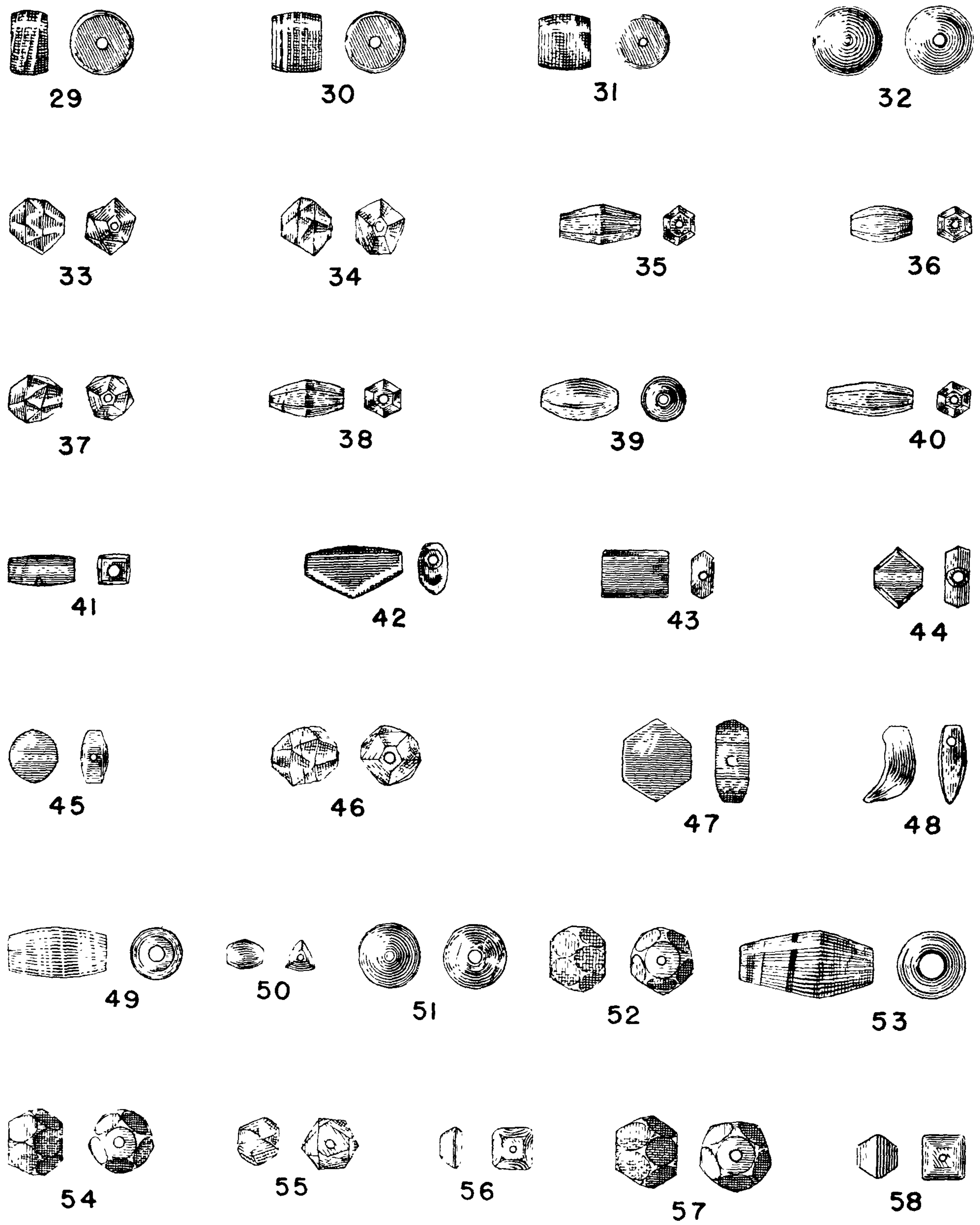

FIG. 2. 29-50, *carnelian;* 51-58, *chalcedony.* $\frac{1}{1}$

31. Short barrel circular.
No. 8937. AC III, KIX/P9a, -60½ ft. Stratum VIII.

32. Spherical.
No. 8935. AC III, KIX/K9k, -59 ft. Stratum VIII.

33. Faceted biconical, twisted pentagonal.
No. 8662. AC III, KIX/K9k, -51 ft. Stratum VI.

34. Faceted biconical, twisted pentagonal.
No. 3832. AC III, KIX/C8g, -42 ft.

35. Long truncated bicone hexagonal.
No. 4211. AC III, KIX/K8d, -41 ft. Stratum I.

36. Long barrel hexagonal.
No. 1353. AC III, KX/F7b, -40 ft. Stratum I.

37. Faceted bicone twisted pentagonal.
No. 1267. AC III, KX/A9a, -39 ft. Stratum I.

38. Long barrel hexagonal.
No. 1293. AC III, KX/A7k, -39 ft. Stratum I.

39. Long barrel circular.
No. 1144. AC III, KX/F6d, -36 ft. Stratum I.

40. Long truncated bicone hexagonal.
No. 1238. AC III, KX/A9b, -36 ft. Stratum I.

41. Long barrel square.
No. 291. AC III, KX/M1g, -33 ft. Stratum I.

42. Long leech-shaped lenticular.
Surface.

43. Standard rectangular hexagonal flattened.
No. 6555. AC V, QVIII/P5b, -73 ft.

44. Standard diamond tabular.
No. 3097. AC V, -62 ft.

45. Circular tabular.
No. 6645. AC V, QVIII/P3j, -60 ft.

46. Faceted bicone twisted pentagonal.
No. 6529. AC V, QVIII/N10c, -42½ ft.

47. Hexagonal tabular.
No. 554. AC I, Trench 3, -55 ft. 8 in.

48. Dagger pendant.
No. 9223. AC VII, HV/C9h.

49. Long barrel circular.
No. 974. AC IV, MIX/N2f, -45½ ft.

50. Standard barrel triangular.
No. 11308. AC XV, RVII/Y9d, -52 ft.

5. BEADS OF CHALCEDONY

Out of the thirteen beads of chalcedony only a few are interesting. Six beads are spherical in shape, the oldest, no. 51, belonging to Stratum VIII. A long barrel circular bead, no. 53, is from Stratum III*a*. Three beads, nos. 52, 54 and 57, represent a variety in which the bicone truncated beads, having a pentagonal section, are faceted in such a way as to have large circular flats on each facet. Two of them are to be dated between 100 B.C. and A.D. 600, while the third one is unstratified. Beads of this variety are first met with at Taxila,[1] where they are to be dated to the fourth-third century B.C., and the flats are found to have a contrasty material like carnelian cemented on them in small plano-convex blocks. In the Indian Museum, Calcutta, there is a long bicone chalcedony bead of this variety with carnelian ' eyes ', also from Taxila (no. I.M. 10052). Similar beads are found at Patna (nos. Sbk 35, 396 and Sk 35, 74 in the Patna Museum), which are believed to be of Mauryan date. It is very rarely that the cemented portion remains adhering to the body and only the ' bases ' of these beads with rounded flats are found in excavations. Such beads have been found in the second century B.C. levels at Kauśāmbī.[2] They also occur in the Śātavāhana stratum at Nāsik, as also at Koṇḍāpur.[3] From the Ahichchhatrā specimens the practice of using these beads seems to have continued at least till A.D. 600. Another interesting specimen, no. 55, is a truncated bicone bead, hexagonal in section, and is of a more recent date (A.D. 850-1100). Beads of identical shape but earlier in date have been found in the Gangetic valley. One cylinder disc bead with convex ends and square in section, no. 56, is an interesting specimen having parallels elsewhere but is unfortunately not stratified. Similar is the case with a truncated bicone square bead, no. 58, which is a surface-find.

Nos. 51-58 (fig. 2 ; pl. XI)

51. Spherical.
No. 8998. AC III, KX/L1d, -60½ ft. Stratum VIII.

52. Standard truncated bicone pentagonal with ground flats.
No. 8766. AC III, KIX/P10c, -56 ft. Stratum VI.

53. Long barrel circular.
No. 6367. AC III, KIX/K6b, -43 ft. Stratum III*a*.

54. Truncated bicone pentagonal.
No. 1392. AC III, KX/F5a, -42 ft. Stratum III*b*.

55. Truncated bicone hexagonal.
No. 1226. AC III, KX/F7b, -40 ft. Stratum I.

56. Cylindrical disc with convex ends, square.
No. 111. AC III, KX/G5a, -38 ft. Stratum I.

57. Truncated bicone pentagonal.
No. 3540. AC III, KX/B5h, -35 ft. Stratum I.

58. Truncated bicone square.
Surface.

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[1] Beck, *op. cit.*, p. 6, pl. II, 34 and 35.
[2] Beads from Kauśāmbī excavation.
[3] Dikshit, *Some Beads from Kondapur*, pl. II, 103 and 104.

6. BEADS OF CRYSTAL

Sixteen crystal beads were found in the excavation, and there are several specimens in the long string of surface-collections. The crystal is generally free from internal fractures and only the most transparent material is used for the beads. The following shapes occur : spherical, 5 ; long barrel circular, 2 ; long cylinder hexagonal, 1 ; long cylinder hexagonal with flattened sides, 1 ; bicone hexagonal, 2 ; lenticular hexagonal, 1 ; faceted bicone hexagonal, 2 ; barrel triangular, 1 ; and long barrel hexagonal, 1.

Among the five spherical beads only one, no. 65, is of special interest. It is not clearly stratified, being found near the surface, but appears to have been a very old specimen. It has a rough pitted surface and has all over the body traces of a green glaze, minute quantities of which are still left in the crevices. Spot-test at the National Chemical Laboratory, Poona, indicates that the bead was fire-polished by putting the glaze on the stone and no attempt was made to use any base like soda or lime to fuse it.

Glazing of stones was practised in the Ancient World, and very early specimens are known from Egypt, Iraq, Syria and India. Beck has already drawn attention to the various processes employed in the glazing of stones and has traced their antiquity from Pre-Dynastic times (S.D. 48) to the XIIth Dynasty in Egypt, 2300 B.C. to 900 B.C. in Iraq and upto the Roman period in Syria.[1] The only known Indian specimens are from Taxila,[2] emanating from Sirkap and the Dharmarājikā Stūpa, and are dated about the first century A.D. The present specimen from Ahichchhatrā, therefore, is an addition to our knowledge.

The shapes of the other crystal beads are more or less uninteresting, being of common occurrence. A long barrel triangular bead, no. 59, is dated 100 B.C.-A.D. 100. A small lenticular hexagonal bead, no. 60, is attributed to Stratum IV*c*. Beads of this shape are frequent at Rājgir[3] and Lauriyā Nandangarh,[4] at the latter place ascribed to the Śuṅga period.

To the Gupta period are attributed three beads of rare beauty. A short cylinder hexagonal bead, no. 61, is an unusually large specimen ; its sides are flattened to lie flat on the neck and its tapering ends are bottom-heavy. Another long cylinder bead with flattened hexagonal sides, no. 62, is a common shape; while a third one, no. 63, a bicone hexagonal faceted bead, has irregular facets.

Two long barrel circular beads, nos. 64 and 66, are chosen here for the purity of their material, free from any flaws, the first attributed to Stratum I and the latter unstratified. Two bicone hexagonal beads, nos. 67 and 68, are from Stratum I and are examples of good workmanship. A standard barrel hexagonal bead, no. 69, a surface-find, is similarly well-worked.

A majority of the crystal beads from Ahichchhatrā shows a striking preference to hexagonal forms, which is probably due to the natural shape of the crystals which requires less cutting and polishing.

Nos. 59-69 (fig. 3 ; pl. XII)

59. Long barrel triangular.
No. 8846. AC III, KX/L1d, -58 ft. Stratum VI.

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[1] Beck, ' Notes on glazed stones ', *Ancient Egypt and East*, June 1935.
[2] Beck, *Beads from Taxila*, pl. V, 1-7.
[3] Beads in the Indian Museum, Calcutta.
[4] *An. Rep. Arch. Surv. Ind.*, 1935-36 (Delhi, 1938), p. 65 ; pl. XXIII.

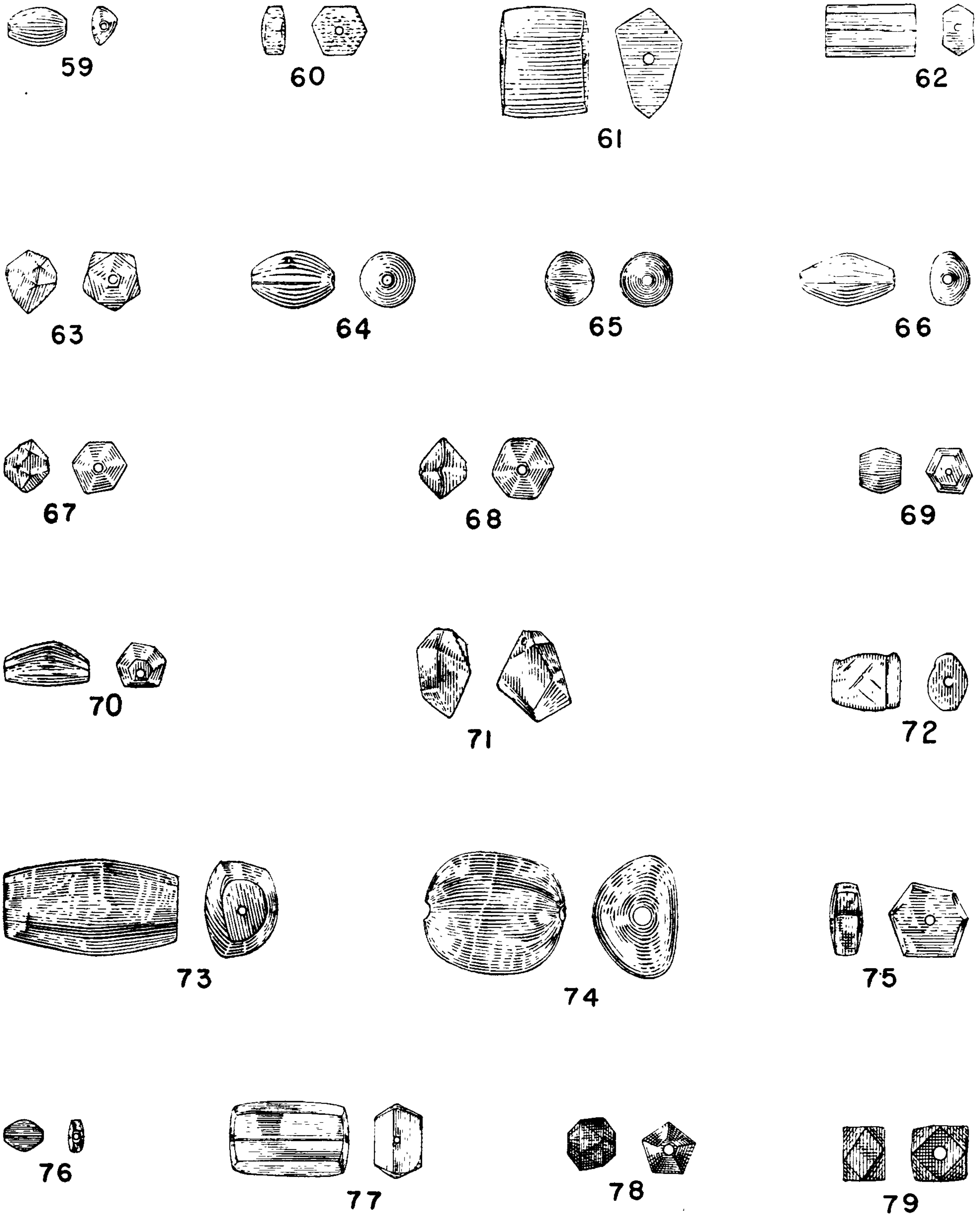

FIG. 3. 59-69, *crystal;* 70 *and* 71, *yellow quartz;* 72, *milky quartz;* 73-76, *amethyst;* 77, *aquamarine;* 78 *and* 79, *green jasper.* $\frac{1}{1}$

60. Lenticular hexagonal.
No. 8361. AC III, KIX/P96, -51 ft. Stratum IV*c*.

61. Short cylinder hexagonal.
No. 6398. AC III, KX/A3h, -46 ft. Stratum III*c*.

62. Long cylinder flattened hexagonal.
No. 8361. AC III, KIX/P9d, -51 ft. Stratum IV*c*. III

63. Bicone hexagonal with irregular facets.
No. 6366. AC III, KIX/K1e, -45 ft. Stratum III*b*.

64. Long barrel circular.
No. 4193. AC III, KIX/K7b, -41 ft. Stratum I.

65. Spherical, with traces of green glaze.
No. 1237. AC III, KX/F6e, -40 ft. Stratum I.

66. Long barrel circular.
No. 1216. AC III, KX/F10k, -39 ft. Stratum I.

67. Bicone hexagonal.
No. 1157. AC III, KX/F5a, -39 ft. Stratum I.

68. Bicone hexagonal.
No. 3843. Surface.

69. Standard barrel hexagonal.
No. 332. Surface.

7. BEADS OF YELLOW QUARTZ

Yellow quartz is the material for four beads from Ahichchhatrā. Two of them are from the lower levels in Stratum VIII and are dated 300-200 B.C. ; the other two, from sectors other than AC III, are not well-stratified. Two (one from AC III and another from AC V) are long barrel hexagonal with alternating large and small facets, while the other two are drop-pendants, prepared from the natural stones in their amygdoloid state, with perforations at the top. Except for their early date there is nothing remarkable about these beads.

Amygdoloid pendants of yellow quartz are very common, specimens being known from Patna, Masaon Ḍīh, Chirayyā Koṭ and Ghosi. A pendant almost similar to no. 71 was obtained in the first century A.D. levels in the Kauśāmbī excavation. Several yellow quartz beads also occur in the Mauryan strata at Tripurī.

Yellow quartz seems to have been a favourite material for beads. At Taxila beads of this material are dated between the third B.C. to the fifth century A.D. Some very fine specimens from Kauśāmbī are preserved in the Allahabad Municipal Museum and in the collection of Shri Jineshwar Das of Allahabad. Two exceptionally well-made beads of yellow quartz from Arikameḍu are in the writer's collection. The use of this stone was prescribed against jaundice, as recorded in Pliny's *Natural History*, xxxvii, 139.

Nos. 70 AND 71 (fig. 3 ; pl. XII)

70. Long barrel hexagonal with alternating large and small facets.
No. 3018. AC V, QVIII/O5j, -45 ft.

71. Faceted drop-pendant.
No. 915. AC IV, MIX/H1j, -43 ft.

8. A BEAD OF MILKY QUARTZ

A milky quartz bead is specially noteworthy. It has a rough barrel shape with groove-collars and is ellipsoid in section. Exactly similar beads have been found at Taxila[1] (two beads, first century A.D.), Kauśāmbī[2] (first century A.D.), Bhīṭā,[3] Rājghāṭ, Tripurī,[4] Kulaon on the Narmadā,[5] Nāsik[6] and Kondāpur.[7] All these beads bear a very high polish resembling glaze, which, on microscopic examination, seems to have been produced by grind-polishing.

No. 72 (fig. 3 ; pl. XII)

72. Roughly barrel with groove-collars, ellipsoid.
No. 11110. AC XV, RVII/Y4h, -50 ft.

9. BEADS OF GARNET

Garnet is represented by a few beads collected as surface-finds, none being recorded in the excavation. Of special interest is a fragmentary tortoise-shaped amulet (not illustrated). The significance of this amulet has been pointed out by me elsewhere.[8]

10. BEADS OF AMETHYST

Only four amethyst beads are recorded, but their material is of a very fine quality. The oldest specimen, no. 73, is a long barrel bead, elliptical in section, one of its surfaces being nearly flat. It is considerably large in size, a peculiarity noticed amongst Mauryan beads, and is dated 300-200 B.C. Another one, no. 74, plano-convex in section, resembles a scaraboid and shows large perforations. It is from Stratum III, belonging to the Gupta period. Of the same age is an elliptical bead, no. 75, hexagonal in section, which has several parallels in north India. Śuṅga beads from Lauriyā Nandangarh[9] are similarly shaped, as also the amethyst beads in the Piprāwāh vase. Examples are also known from Rājghāṭ, Kauśāmbī and Bulandībāgh (Patna Museum, no. Sq. 31 Ka3/159). Recently a few have been found at Tripurī and at Kulaon on the Narmadā. An extremely tiny flat barrel bead, no. 76, tabular in section, is unstratified.

Nos. 73-76 (fig. 3 ; pl. XII)

73. Long barrel elliptical.
No. 10854. AC III, KX/L1c, -61 ft. Stratum VIII.

74. Elliptical plano-convex.
No. 8449. AC III, KIX/E8d, -43 ft. Stratum III*a*.

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[1] Beck, *Beads from Taxila*, pl. V, 1.
[2] Beads from Kauśāmbī excavation.
[3] Beads in the Lucknow Museum.
[4] Found in 1952-excavation.
[5] Author's collection (for this and subsequent references to Kulaon).
[6] Found in 1951-excavation.
[7] Dikshit, *Some Beads from Kondapur*, pl. II, 61.
[8] Dikshit, 'Notes on Indian amulets', *Bulletin of the Prince of Wales Museum, Bombay*, no. 2 (Bombay, 1953), pp. 92-93.
[9] Specimens in the Indian Museum, Calcutta.

75. Elliptical hexagonal.
No. 6369. AC III, KIX/K5a, -43 ft. Stratum III*a*.

76. Long barrel tabular.
Surface.

11. A BEAD OF AQUAMARINE

Aquamarine or beryl is represented by a single specimen, no. 77, which is not accurately dated but may be of Gupta date. It is an exceptionally well-made bead, perhaps the best one in the collection from Ahichchhatrā. It is flat cylinder with the corners rounded and hexagonal in section. At the short ends of the bead a vertical groove runs across the perforation. The perforation of this bead, which is about $\frac{7}{8}$ in. in length, seems to have been done in a single operation, the lapidary having taken advantage of the transparency of the material. It seems probable that the grooves at both the ends were intended to serve as a guide-mark for his drill. The minuteness of the drill and his ability to meet the bore in the same axis, in case it was doubly perforated, are very remarkable.

No. 77 (fig. 3 ; pl. XII)

77. Cylinder hexagonal with corners rounded. Vertical grooves at the short ends.
No. 9251. AC VII, GV/D7c, -41 ft.

12. BEADS OF GREEN JASPER

There are only three jasper beads in the collection, all of them from areas other than AC III and therefore not firmly dated. The shapes represented are twisted pentagonal (no. 78) and cornerless cube (no. 79), which are fairly common in jasper beads, and I have already referred (above, p. 40) to the prevalence of the former in the Śātavāhana period in the Deccan.

Nos. 78 AND 79 (fig. 3 ; pl. XII)

78. Faceted twisted pentagonal.
No. 732. AC I, Trench I, -63$\frac{3}{4}$ ft.

79. Cornerless cube.
No. 3020. AC V, -43 ft.

13. BEADS OF MISCELLANEOUS MATERIALS

A few sundry beads, comparatively recent in date, are described below, with their materials and shapes.

Nos. 80-82 (fig. 4 ; pl. XIII A)

80. Shell : circular tabular.
No. 6809. AC III, unstratified.

81. Bone : long cylinder circular.
No. 3509. AC III, KX/A8k, -42 ft. Stratum I.

82. Seed : drop-shaped bead, horizontally perforated.
No. 9235. AC VII, HV/J9a, -36 ft.

The circular shell bead is of very little interest, being a very common shape. The bone bead has been prepared by enlarging the cavity in a tubular long bone. The natural seed bead has been identified as *Coix Lacryma Jobi*. Linn.[1] by Dr. R. D. Misra of the Botany Department, University of Saugor.

14. A PENDANT OF SERPENTINE

No. 83 is a very fine pendant, its material being serpentine. It is about ½ in. in length and shows a pregnant woman in a squatting position with bent legs. Considering the hardness of the material this bead has been carved with great skill and minuteness of detail. The subject represented by this pendant is somewhat unusual and by the doctrine of ' similars ' there is reason to believe that it was used as a charm against difficult labour.

I have not seen any analogous instance of the charm represented by the present specimen. Unfortunately this pendant is not very accurately dated, but the manner of depicting the figure closely imitates Śuṅga art and on stylistic grounds it may be of that period.

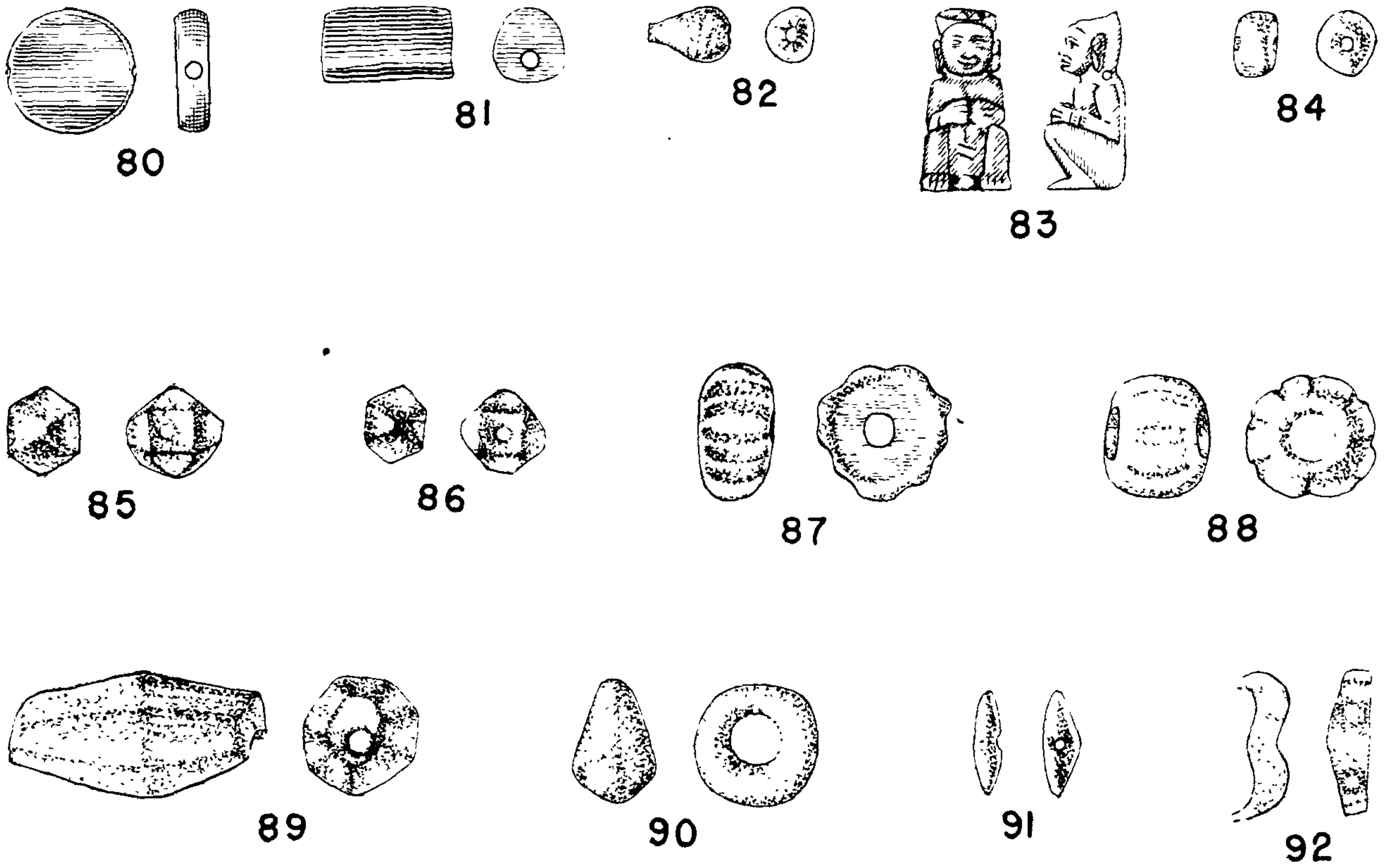

FIG. 4. 80, *shell* ; 81, *bone* ; 82, *seed* ; 83, *serpentine* ; 84-92, *faïence*. $\frac{1}{1}$

[1] Cf. N. L. Bor, ' Common grasses of the United Provinces ', *Indian Forest Records*, II, i (1940), pp. 99-100. This seed is largely used by the poor in U.P. on account of its hard and smooth shell. It is called *kavaḍeṇā* from its resemblance to the cowrie-shell ; and the plant grows wild in marshy places. Similar seed beads were found in the Kolhāpur excavations also, but the material was not identified.

No. 83 (fig. 4 ; pl. XIII A)

83. Pendant showing a pregnant woman in a squatting position with bent legs.
No. 6587. AC V, QVIII/P4j, -73½ ft.

15. BEADS OF FAÏENCE

Faïence is the material for seventeen beads from Ahichchhatrā. With the exception of four beads from areas other than AC III, all are clearly stratified and belong to Stratum III. Only two among the beads are white, the rest being coloured green. Some of the latter bear a very high glaze, but many of the larger specimens are very coarse-grained and have a pitted surface.

The shapes of these beads are usual, viz. spherical beads, 4; long barrel circular, 4 ; cornerless cube, 4 ; and *āmalaka*-shaped, 2. The less common forms are : double crescent, 1 ; truncated bicone, septagonal in section, 1 ; and flat diamond-shaped toggle, 1.

Amongst the four spherical or oblate beads, one, no. 84, bears an excellent high glaze and is fire-polished. Three (one, no. 85, illustrated) amongst the four cornerless cube beads show signs of high glazing and being fire-polished have their edges considerably worn out ; the fourth specimen, no. 86, however, retains the edges and is a perfect specimen of moulding.

The most favourite shape amongst faïence beads, viz. the *āmalaka*, is represented only by two beads, nos. 87 and 88, but both are unstratified. One of them has a pitted surface owing to bad firing, while the other, having the gadroons effected by notches all over the body, retains much of its original green glaze.

Āmalaka-shaped faïence beads are found on several sites in India, both in the north and the south, and on account of their universal character it is hardly necessary to enumerate them. Their distribution in the Śātavāhana period in the Deccan is particularly noteworthy ; and most of the beads from northern India that I have seen belong to about the same period.

Amongst the less frequent forms the following beads are noteworthy. No. 89 from Stratum III, is a rare and unusually large biconical bead with irregular septagonal faceted section. Its surface is pitted and shows a pottery-like core beneath. It was covered over with a green glaze but only traces now remain in the cavities.

Another rare form is represented by a wedge-shaped annular bead, no. 90, also from Stratum III, and is lightly glazed. This shape is very scarcely met with in faïence beads.

A lenticular, diamond-shaped toggle bead, no. 91, is not clearly stratified. It is of white hard faïence and is not well-perforated. A bead almost similar to this was examined by me amongst the beads from Koṇḍāpur, and two specimens from Kauśāmbī are preserved in the Allahabad Museum. But beads of this shape are scarcely met with.

The most interesting bead in this series is a large double-crescent spacing bead, no. 92, from an early level of Stratum III. It is of white faïence, covered with traces of a green glaze. It has the shape of the English numeral 3, with a flat underside and a projecting mid-rib on the other. Two holes occupy the central portion of the joined crescents.

Exactly identical faïence beads, dated about the first century A.D., are known from Taxila,[1] and similar ones, also of faïence, dated about the second century A.D., are also recorded from Charsadda.[2] Recently I saw an identical bead of this shape from Sāmbhar in the Jaipur Museum, but its date is not known.

[1] Beck, *Beads from Taxila*, pl. X, 5 and 6.
[2] *An. Rep. Arch. Surv. Ind.*, 1902-3 (Calcutta, 1904), pl. XXVIII *b*, 3.

The antiquity of this shape can be traced back to the Harappan times of India, since a similar bead of burnt steatite has been found at Harappā.[1] Outside India similar beads have been recovered from Jemdet Nasr.[2] Two of these are of glazed paste (faïence?) and the third one is of mother-of-pearl.

It is interesting to note that none of the faïence beads from Ahichchhatrā is dated prior to A.D. 350. This material, which was very extensively used for the manufacture of beads, bangles and other objects during the Harappan times, seems to have been unknown or at least very sparingly used during the Mauryan period. At Taxila only two beads are reported to have been found in Bhīr Mound. Among the beads found in the Allahabad University excavations at Kauśāmbī, there are no faïence beads which can be attributed to a period prior to 150 B.C. Similarly they are absent from the Mauryan strata at Tripurī and are not reported from the pre-Śātavāhana levels at Nāsik. Faïence beads gained a very wide popularity from about early centuries of the Christian era, as is evinced from the very large numbers recovered from Sirkap, from Charsadda and other sites in north India ; in the Deccan these were a particular favourite during the Śātavāhana period. The material seems to have lost its appeal with the extensive use of glass, though its use in the Gupta times is evinced from the stratified specimens from Kauśāmbī and Ahichchhatrā. I have not seen any faïence bead which could reliably be dated to a period subsequent to the Gupta age, and even the specimens later than the second-third centuries A.D. are not large in number. With the known cultural relations of India with Persia during the Mauryan period, the absence of faïence, for the use of which Persia is so famous, is striking.

Nos. 84-92 (fig. 4 ; pl. XIII A)

84. Oblate circular.
No. 90. AC III, Trial Trench, -43 ft. 4 in.

85. Cornerless cube, glazed in green.
No. 3911. AC III.

86. Cornerless cube, with traces of green glaze.
No. 6451. AC III, KIX/K7f, -46 ft. Stratum III*b*.

87. *Āmalaka*-shaped, with traces of high green glaze.
No. 9071. AC VII, GV/C6e, -39 ft.

88. *Āmalaka*-shaped, with traces of high green glaze.
No. 10002. AC I, Room 3, -42 ft.

89. Long bicone septagonal.
No. 8300. AC III, KIX/K7a, -46 ft. Stratum III*b*.

90. Wedge-shaped annular.
No. 4109. AC III, KIX/K2e, -40 ft. Stratum I.

91. Lenticular diamond-shaped toggle.
No. 3926. AC III.

92. Double-crescent plano-convex spacer.
No. 3859. AC III, KX/F8c, -48 ft. Stratum III*d*.

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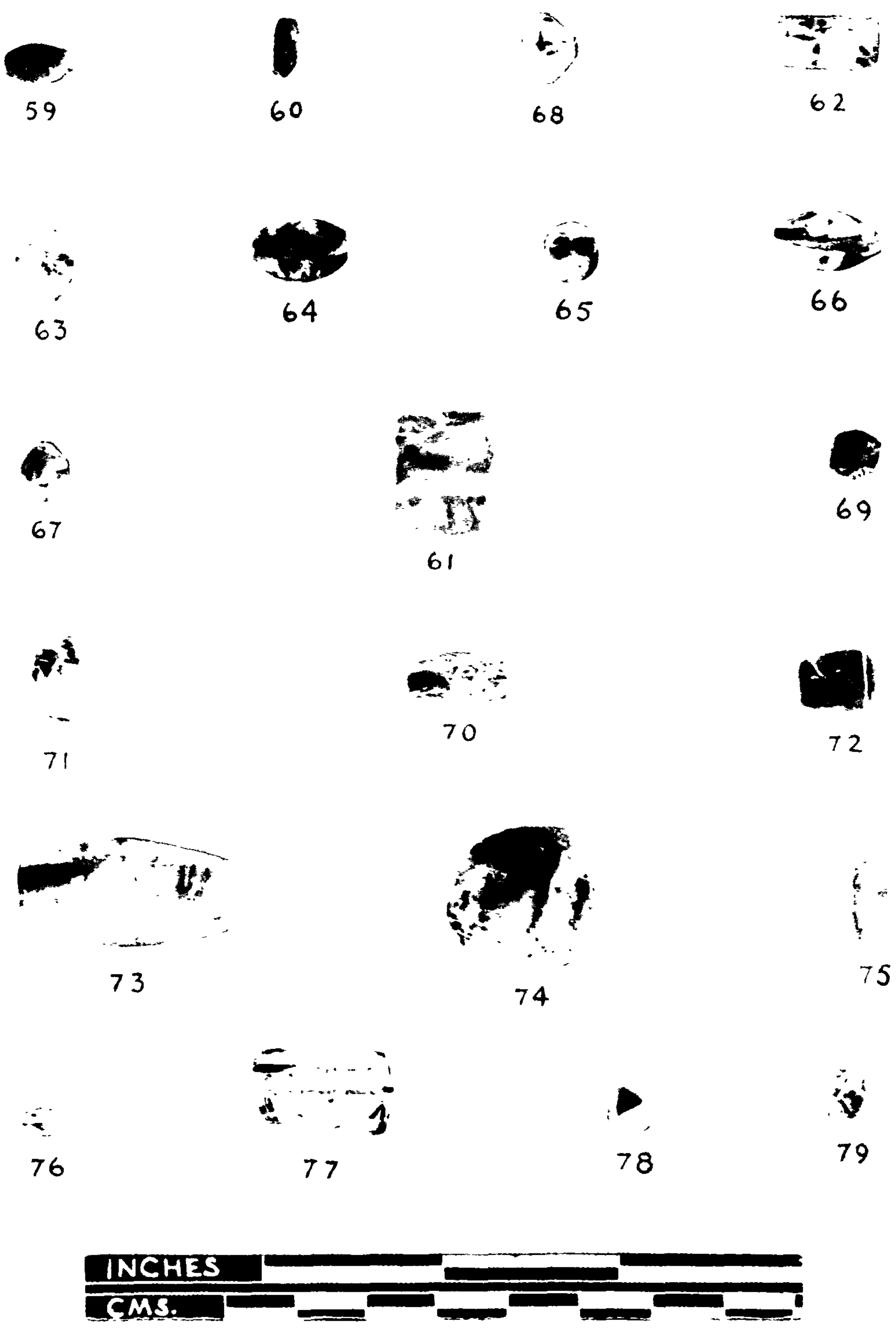
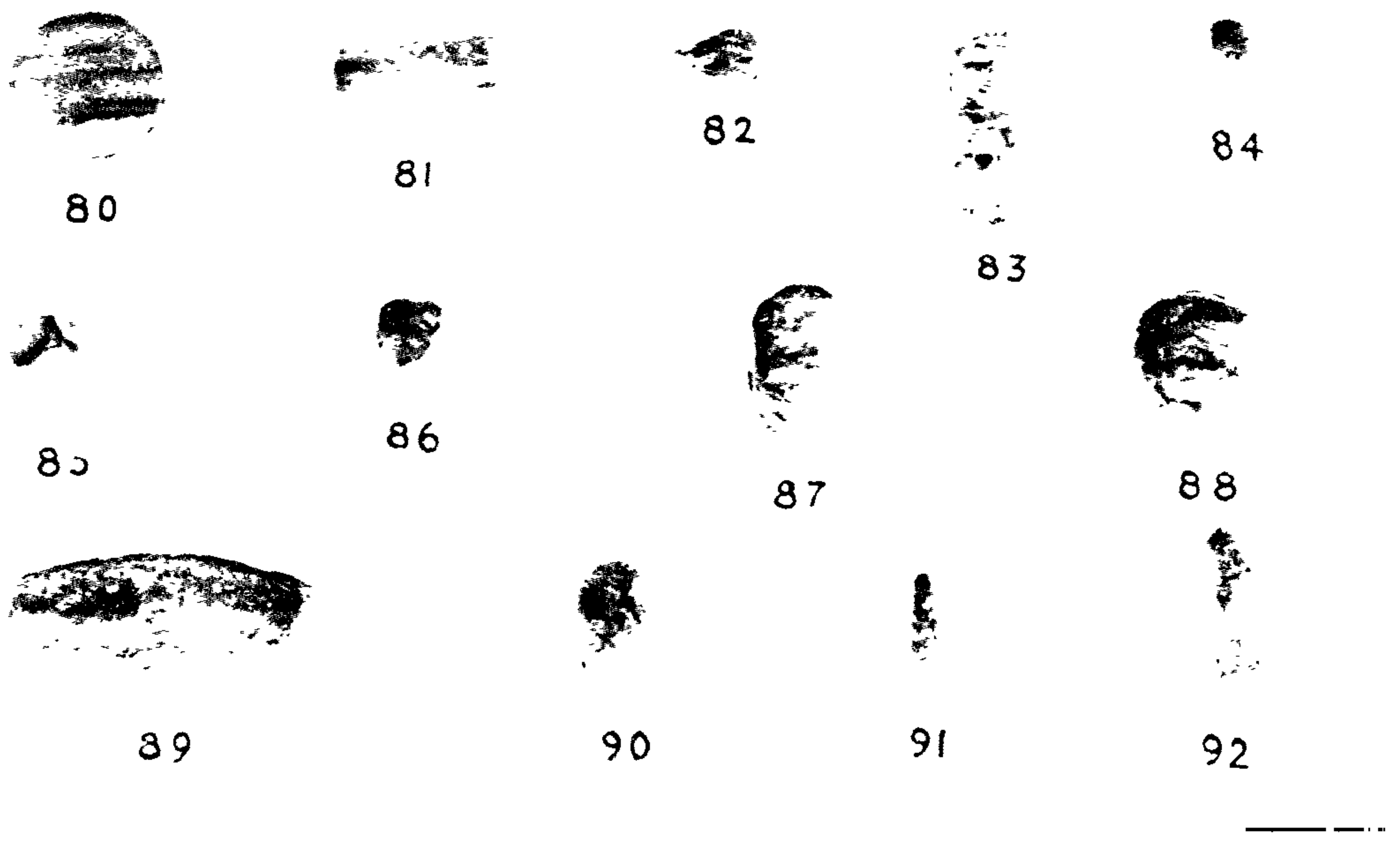
[1] Vats, *op. cit.*, II, p. 441, pl. CXXXIX, 32.

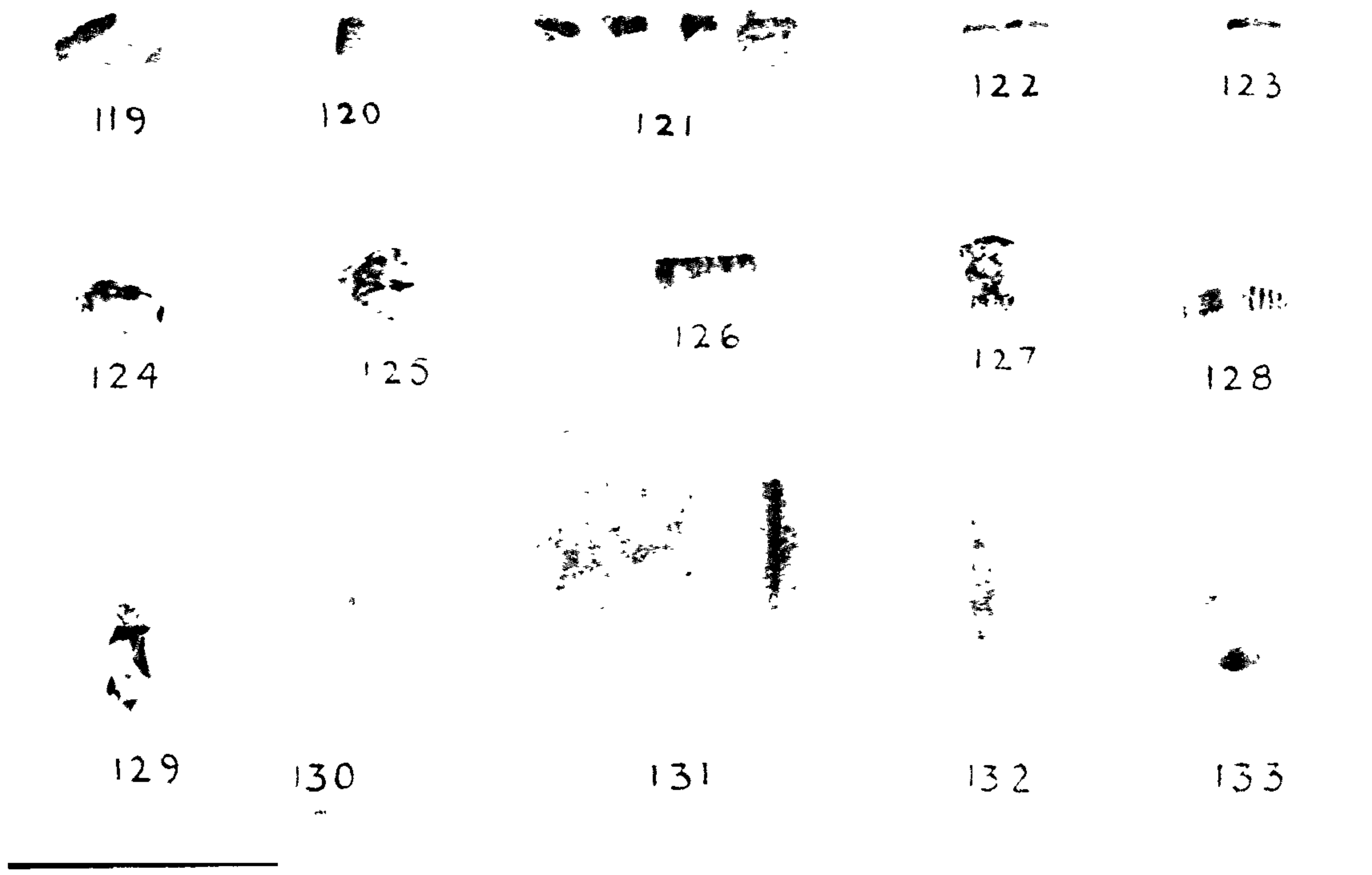
[2] E. Mackay in *Field Museum of Natural History, Anthropology, Memoir*, I, no. 3 (Chicago, 1931), pls. LXXIV, 6, LXXII, 27-29, and LXII.



59-69, *crystal;* 70 *and* 71, *yellow quartz;* 72, *milky quartz;* 73-76, *amethyst;* 77, *aquamarine;* 78 *and* 79, *green jasper*



A. 80, *shell;* 81, *bone;* 82, *seed;* 83, *serpentine;* 84-92, *faience.* $\frac{1}{1}$



B. 119, *blue millifiori glass;* 120, *orange glass;* 121, *gold-foil glass;* 122, *dark-red opaque glass;* 123, *bright-red glass;* 124 *and* 125, *black glass;* 126-129, *copper;* 130-133, *terracotta.* $\frac{1}{1}$

16. BEADS OF GLASS

More than one hundred glass beads were recovered from excavations, and besides there are several in the string of surface-collections sent to me. In the following classification I have taken into consideration only those from the stratified deposits and a few, of exceptional interest, from the surface-collection. The shape of these beads, the technique of their manufacture and their general distribution have naturally received primary attention ; but I have taken very little aid of the chemist, whose judgment should remain final in the matter of a technical subject like glass. The similarities which I have pointed out are, therefore, on the basis of a large collection of glass beads I possess or have examined in different museums and from the notes I have made.

A. Green glass

Twentyeight beads of green glass were recorded in the excavations. These have different shades of green ranging from a bright leaf-green to a dull green and differ in the degree of opacity, twelve being transparent and the rest opaque. The colouring agent appears to be copper in most of the cases, but three or four seem to be coloured with iron. Various processes are used in the manufacture of these beads. While most of the beads are made by the wire-wound process, there are a few moulded beads. Occasionally these are made from canes and are folded. A thin film of salts is visible on several transparent beads and a simple immersion-test in pure water often proved to be useful for the identification of the original colour.

The beads are distributed in practically all strata ; there is only one from Stratum VIII, while none is forthcoming from Stratum IV. This absence is no doubt adventitious.

Only a few beads are noteworthy for their shapes. Besides the common shapes, like spherical and oblate beads, there are a number of hexagonal forms (barrel, cylinder and flattened), cornerless cubes and circular lenticular. Some rare shapes (nos. 97 and 107) are a curved pendant and a double chamfered cylinder, square in section (Beck's Type IX.D.2, b.d.).

Transparent glass, nos. 93-100 (fig. 5 ; pl. XIV)

93. Long cylinder hexagonal. Moulded. Transparent bluish green, full of bubbles, edges cut and fire-polished.
No. 1283. AC III, KX/F9a, -39 ft. Stratum I.

94. Long cylinder hexagonal. Folded, made by the double-strip method round a spoke. Cane glass, full of horizontally-pulled bubbles.
No. 3034. AC V, QVIII/O4h, -42½ ft.

95. Standard cylinder circular. Probably folded. Transparent green, crackled at various centres. Hole bored by a sharp instrument, leaving depression at the edges.
No. 9389. AC VII, GIV/E2f, -40 ft.

96. Standard barrel hexagonal. Moulded. Transparent bluish green, well-made.
No. 1394. AC III, KX/F7h, -39 ft. Stratum I.

97. Curved pendant. Moulded and bent. Greenish transparent, coloured with copper. Well-made.
No. 899. AC IV, MIX/H3e, -36 ft.

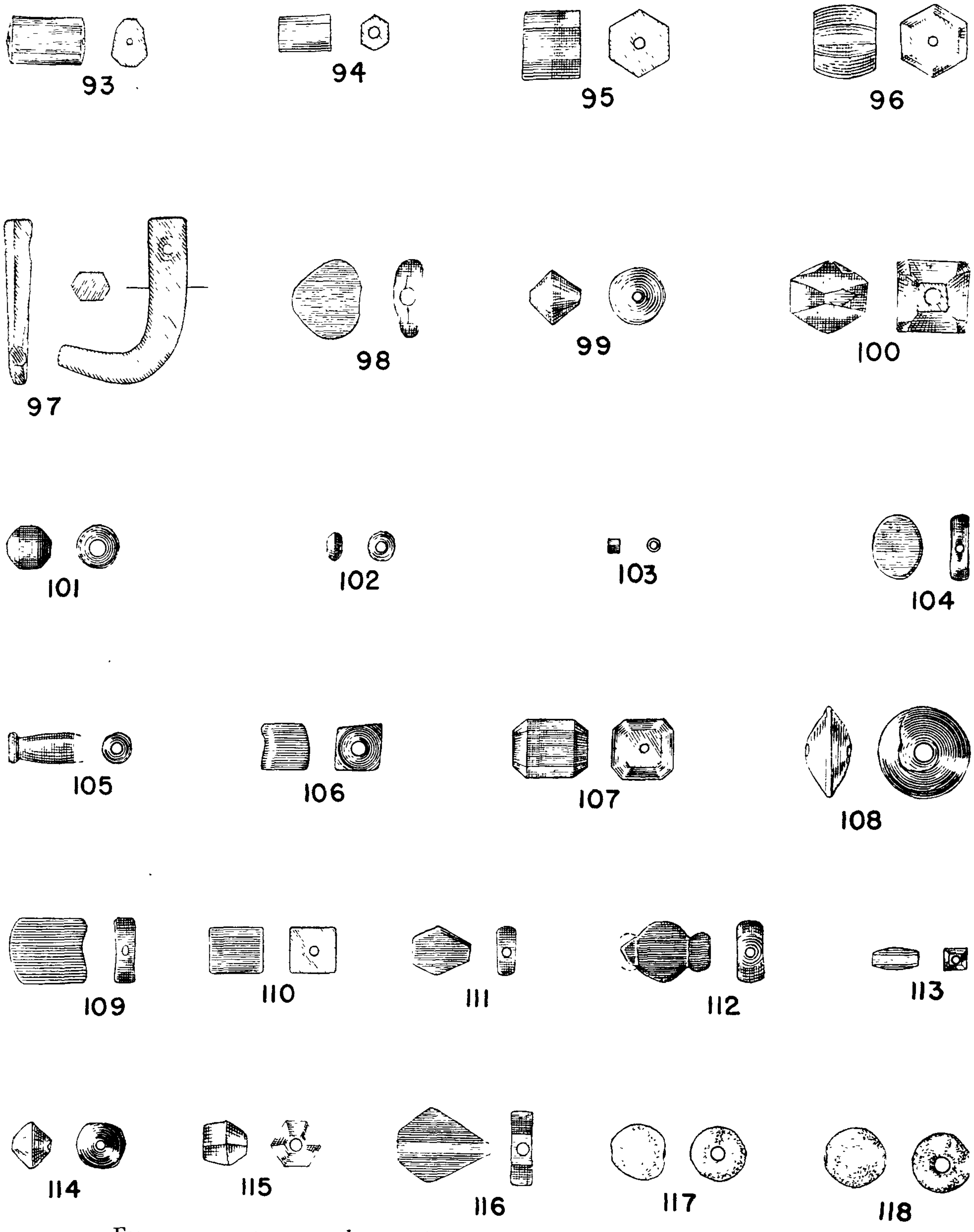


FIG. 5. 93-107, *green glass* ; 108-11, *blue-green glass* ; 112-118, *blue glass*. $\frac{1}{1}$

98. Pear-shaped lenticular. Folded, Transparent green full of bubbles and coloured with iron. Hole bored by a sharp instrument leaving a depression at one end and a blurred edge, at the other, giving the bead a pear-shaped appearance.
No. 3087. AC V, –48 ft.

99. Bicone circular. Produced by the wire-wound process. Iridescent pale green, full of impurities.
No. 3183. AC V, QVIII/P4g, –65½ ft.

100. Cornerless cube. Iridescent bluish green, with surface-corrosion. Well-made.
No. 255. AC III, KX/B4j, –34 ft. Stratum I.

Opaque glass, nos. 101-107 (fig. 5 ; pl. XIV)

101. Spherical. Produced by the wire-wound process. The only example of bright leaf-green glass at Ahichchhatrā, matched by several beads from the Bahmanī stratum at Kolhāpur and by many unstratified beads from Maski, Paiṭhaṇ and Chandravalli.
No. 4302. AC III, House III. Stratum I.

102. Elliptical circular. Leaf-green, the oldest specimen of this colour at Ahichchhatrā. Cracked surface, probably cane-glass.
No. 10835. AC III, KX/L1a, –60½ ft. Stratum VIII.

103. Standard cylinder circular, measuring $\frac{1}{32}$ in., thus being the tiniest of its class at Ahichchhatrā.
No. 3543. AC III, KX/F8d, –43 ft. Stratum III.

104. Elliptical tabular. Folded. Dull green, with impurities.
No. 8660. AC III, KX/L1a, –54 ft. Stratum V.

105. Long barrel circular lug-collared, one end broken. Cane-glass. Dull green.
No. 6405. AC III, KIX/K4e, –43 ft. Stratum I.

106. Cube. Folded, showing the fold near the perforation. Slightly corroded.
No. 3552. AC III, KX/A6g, –35 ft. Stratum I.

107. Cylinder square with double chamferred edge. Moulded, cracked at various centres. Pale green with yellow veins and impurities.
No. 1057. AC III, Room 128, –35 ft. Stratum I.

B. Blue-green glass

There are twelve beads of blue-green glass, which resembles the Persian blue shade. Only three amongst them are stratified and are attributed to Strata IV*c* and I. These are mostly of cane-glass wound on a spoke and in several cases flattened to form a lenticular shape when the glass was plastic. Only four beads in this series are illustrated.

Nos. 108-111 (fig. 5 ; pl. XIV)

108. Bicone circular. Produced by wire-wound process.
Surface.

109. Rectangular tabular. Produced by wire-wound process and flattened to shape.
Surface.

110. Rectangular square. Moulded.
No. 10204. AC IV, MIX/N7j, –42 ft.

111. Diamond-shaped tabular. Wound cane flattened to shape.
No. 9322. AC VII, GIV/E5c, –40 ft.

C. Blue glass

Of the thirtythree blue glass beads a very large percentage is coloured with cobalt or copper, the former having a very deep shade of blue and the latter with a pale shade of blue. These are distributed in Strata IV to I. The glass is generally of a very good quality and the beads are moulded, there being only a few instances of cane-glass.

The shapes do not indicate much variety, the most popular shape being spherical and oblate beads. There are four short cylinder beads ; only one example, no. 112, has a barrel shape with a lenticular section and lug-collars and belongs to Stratum IV*a*, being in conformity with a large number of similar specimens of comparable date in north and south India.

No. 112 (fig. 5 ; pl. XIV)

112. Barrel with lug-collars, lenticular.
No. 6987. AC III, KIX/P6a, -48 ft. Stratum IV*a*.

Another variety of blue glass, having a very bright turquoise shade, is represented by nine beads. None of these is dated earlier than A.D. 350. Besides the usual spherical and oblate shapes, the following are noteworthy.

Nos. 113-116 (fig. 5 ; pl. XIV)

113. Long barrel square. Shaped on a spoke.
No. 6971. AC III, KIX/E6f, -45 ft. Stratum III*a*.

114. Bicone circular. Same glass as above.
No. 1137. AC III, KX/A4j, -43 ft. Stratum III.

115. Bicone hexagonal with annular perforation. Same glass as above.
No. 3088. AC V, QVIII/O7j, -49 ft.

116. Diamond-shaped tabular. Folded.
No. 9227. AC VII, GV/D8e, -41 ft.

Besides these there are two very old specimens of blue glass, the colour of which cannot be matched on account their iridescent surface. Immersion in water renders them pale bluish and indicate that they are of cane-glass. These have the common spherical shapes and are valued only on account of their high antiquity.

Nos. 117 and 118 (fig. 5 ; pl. XIV)

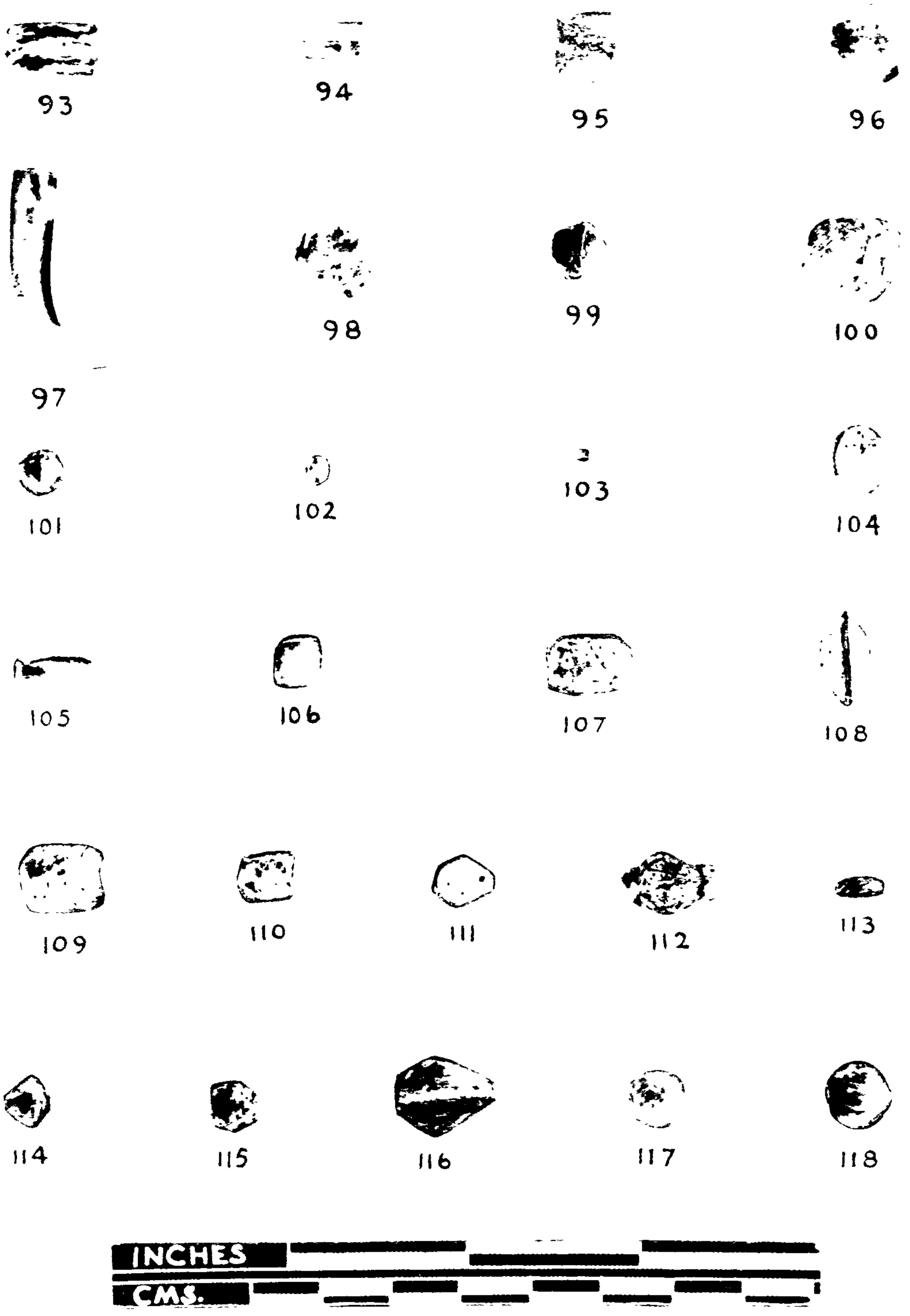
117. Spherical. Cane-glass. Pale blue, iridescent. Much corroded.
No. 8903. AC III, KX/L1b, -60 ft. Stratum VIII.

118. Spherical. Pale blue, highly iridescent.
No. 3178. AC V, QVIII/P4h, -63½ ft.

D. Blue millifiori glass

Of special interest to the technician is a small barrel lenticular bead with lug-collars, having a millifiori pattern on it. It is a folded bead having a blue core, and the decoration consists of several vertical hatchings in red, white and black in a double-black border. The pattern is laid slantingly across the body of the bead. This mosaic bead is unfortunately not very clearly stratified, but similar beads appear to have had a wide

PLATE XIV



93-107, *green glass;* 108-111, *blue-green glass;* 112-118, *blue glass*

distribution in the Gangetic valley. Two identically decorated specimens are in the Lucknow Museum, said to have come from Bhīṭā. I have seen another specimen from Rājghāṭ, in the Bhārat Kalā Bhavan, Banaras, and a third one, from Madhuri, is in the author's collection.

No. 119 (fig. 6 ; pl. XIII B)

119. Long barrel lenticular with lug-collars. Folded, with blue core. Decoration consists of several vertical hatchings in different colours in a double-black border.
No. 993. AC IV, MIX/H6b, -40 ft.

E. Orange glass

Seven short barrel annular beads are of an orange-coloured glass and are distributed in Strata IV and III (A.D. 100-750). A microscopic examination shows that the orange colour is due to cuprous oxide held in small particles and the dull opaque appearance is due to devitrification of the glass. This glass is invariably opaque; and annular is the common shape in the majority of the beads from various sites I have examined. The earliest specimens of this glass are from Taxila (fourth century B.C.) ; at Kauśāmbī beads of this glass are dated 50 B.C. to A.D. 200. At Tripurī, annular beads occur in Stratum IV and are dated about A.D. 200. A few specimens from Ujjain are preserved in the Gwalior Museum but are not accurately dated. A string of two hundred and eighty beads of this glass collected from Birbhum by Mr. E. F. O. Murray is in my possession.

From the number of known specimens it appears that annular beads of this variety of orange glass were very popular in the early centuries of the Christian era.

No. 120 (fig. 6 ; pl. XIII B)

120. Tabular annular.
No. 6602. AC V, QVIII/N9a, -42 ft.

F. Red glass with white core

Amongst the surface-collections of red glass beads, one specimen (not illustrated) is very interesting. It is a cylinder tube bead, having a white porcelainous matrix, over which a transparent red-coloured glass is coated. Beads of this variety of glass occur in the Śātavāhana stratum at Koṇḍāpur[1] ; and a solitary specimen associated with Roman potsherds was dug out from a tank in the Kanheri caves near Bombay. They are also known from Patna (Patna Museum no. Sbk. 35/670) in the Bulandībāgh excavations. This glass, probably Venetian in origin, is also seen amongst the imported beads in Ladakh.[2] They are also known from Rhodesia[3] and Fayum in Egypt.

G. Gold-foil glass

Eight beads are of gold-foil glass. This is a special type of glass beads in which a layer of gold foil is pressed on a glass matrix when hot and is laid over again with another

[1] Dikshit, *Some Beads from Kondapur*, pl. IV, 212.
[2] Cf. *Indian Antiquary*, XXXIV (1905), p. 209.
[3] *Bulletin of the Baroda Museum*, III, pt. 1 (1945-46), p. 55 ; see also Beck's report on Rhodesian beads in Caton-Thompson, *Zimbabwe* (Oxford, 1931) and on the beads from Mapungubwe in Foucher, *Mapungubwe* (Cambridge, 1937), pp. 103-13.

coating of transparent glass. As the foil is not a good cementing material, the material does not form a homogeneous mass and the tendency of the beads is to break at the foil-layer. This accounts for the several fragmentary beads recovered from excavations.

A unique feature of the present collection is a row of four segmented beads, no. 121, which have not been separated for being made into individual beads. The matrix is made of long canes and, when overlaid with foil, appears to have been dipped into a batch of colourless glass. The flakes of this secondary layer of glass show signs of corrosion starting from numerous centres and have a crackled appearance.

Most of the beads are unusually large spherical or standard barrel in shape and have a collar-like effect at the edges where they are separated by notches made in the long cylindrical tubes out of which they are prepared.

Beads with gold foil have a very large distribution in India. In northern India they are known from Bhīṭā, Patna, Masaon Ḍīh, Kauśāmbī, Ujjain and Tripurī. At Bhīṭā they were recovered in the 1909-10 excavations but were not very accurately dated.[1] At Kauśāmbī seven specimens are dated 300 B.C. to the second century A.D. The Tripurī specimens occur in Stratum IV and are dated about A.D. 200. The rest of the specimens are from surface-collections and are therefore not datable.

In south India beads inlaid with gold foil are found in the Śātavāhana strata at Nāsik, Kolhāpur,[2] Koṇḍāpur,[3] Chandravalli, Karāḍ[4] and Arikameḍu.

The beads from Ahichchhatrā occur mostly in Stratum III (A.D. 350 to 750), and two small fragments are from Stratum I. From the four beads in segments referred to above it appears that they were manufactured locally.

No. 121 (fig. 6 ; pl. XIII B)

121. Four segmented circular beads. Matrix made of long canes.
No. 8065. AC IV, MIX/N2b, -44 ft.

H. Red glass

(i). *Dark-red opaque*

Five beads are of a dark-red opaque glass and are distributed in Strata VIII to II. With the exception of one bead, which is moulded, all are made from long canes and are fire-polished. They are the usual cylinder oblate beads and represent a common shape of copper-red glass very widely distributed throughout India. At Kauśāmbī this glass is known to be popular in the second century A.D., but one specimen is dated about 200 B.C. At Patna beads of identical glass occur in depths ranging from 7 to 21 ft. below surface at the Kumrāhār site (thirtysix beads in the Patna Museum) ; a very large collection of similar beads from Dhalbhum Pargana, District Singhbhum, is in the writer's collection. They are frequent also at Rājghāṭ, Masaon Ḍīh and Ghosi, and I have seen a few beads of this glass from Taxila in the Indian Museum, Calcutta. In the excavations at Tripurī they are quite common in the second century A.D. levels. The Gwalior Museum preserves some beads of identical glass from Ujjain. In the south such beads are known from Maski, Koṇḍāpur, Paiṭhaṇ, Nāsik, Chandravalli and Arikameḍu. At Kolhāpur they

[1] *An. Rep. Arch. Surv. Ind.*, 1910-11 (Calcutta, 1914), pp. 92-94.
[2] Sankalia and Dikshit, *op. cit.*, p. 144.
[3] Dikshit, *Some Beads from Kondapur*, pl. IV, 206-09.
[4] M. G. Dikshit, *Exploration at Karad* (Poona, 1949), pl. XI*a*, 5-6.

are associated with the Śātavāhana stratum, and the same date is provided by several specimens from the Arikameḍu excavations.

The solitary bead from Stratum VIII is the only early example of this glass known to me, along with the other specimen known from Kauśāmbī (200 B.C.).

A microscopic examination reveals copper as the main colouring agent for these beads.

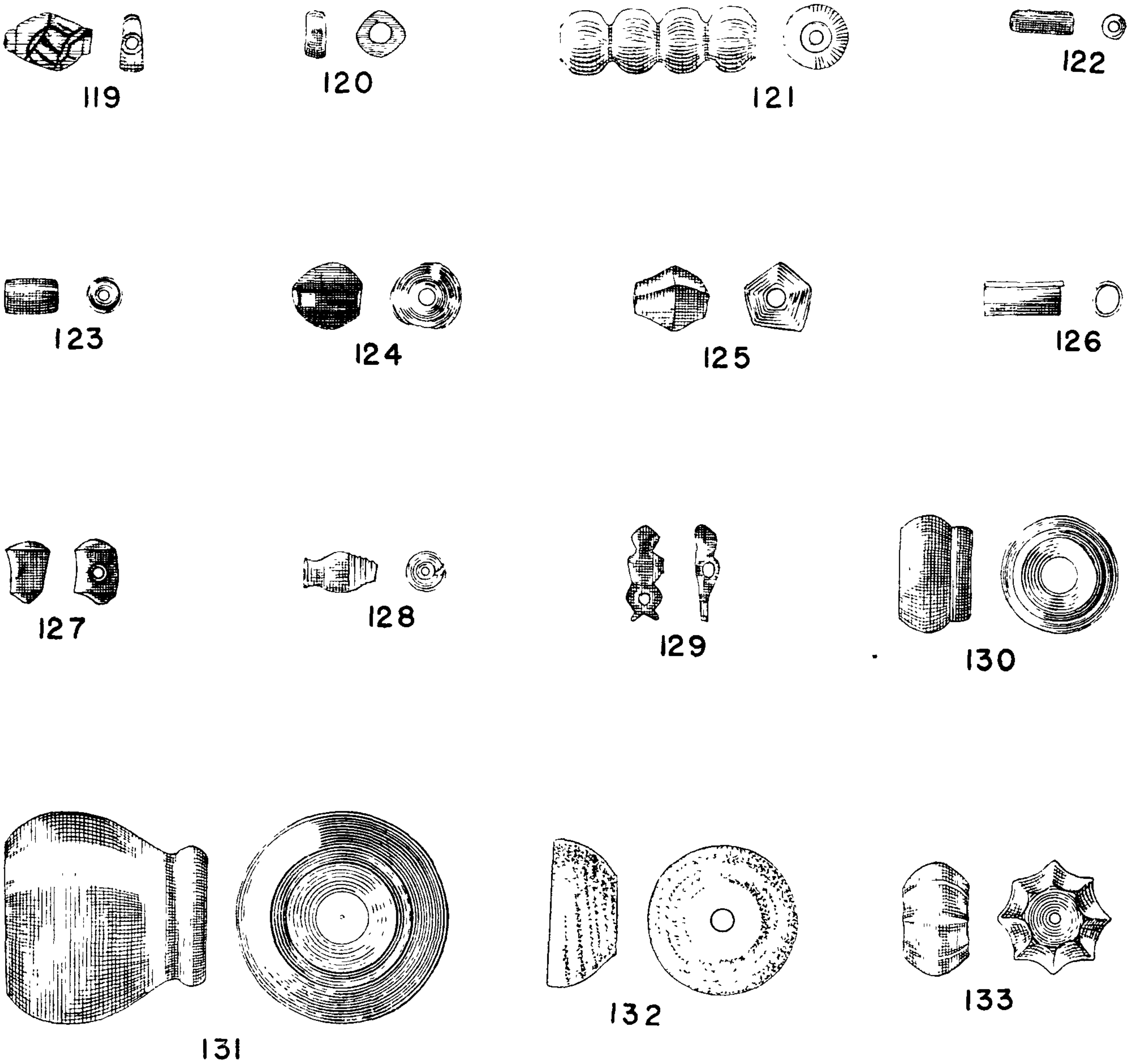


FIG. 6. 119, *blue millifiori glass;* 120, *orange glass;* 121, *gold-foil glass;* 122, *dark-red opaque glass;* 123, *bright-red glass;* 124 *and* 125, *black glass;* 126-129, *copper;* 130-133, *terracotta.* $\frac{1}{1}$

No. 122 (fig. 6 ; pl. XIII B)

122. Long cylinder circular.
No. 3733. AC III, KX/A7h, -43 ft. Stratum II.

(ii). *Bright red*

Besides the dark-red beads referred to above, the collection includes a large bright-coloured red bead. The bead, no. 123, not clearly dated, is opaque and its colour is almost similar to the *gunjā* berry-seed, which is very largely used by goldsmiths in India for weighing purposes. I have seen some aboriginal women wearing identical glass beads, which they believe is prepared out of some seed. A few specimens from Mānḍlā and Bastar, Orissa, are also preserved in the Central Museum, Nagpur.

No. 123 (fig. 6 ; pl. XIII B)

123. Long cylinder circular.
No. 992. AC IV, MIX/N1f, –45 ft.

I. Black glass

Black glass is represented by fifteen specimens, of which nine emanate from stratified deposits. The oldest specimen, no. 124, is attributed to Stratum IX, thus being the earliest recorded specimen. There are three beads from Stratum VIII and two from Stratum I, leaving a wide gap for the intervening period. Some amongst six unstratified beads may belong to this period, and it is fairly certain that black glass was in use at the site throughout its life. There is nothing noteworthy about their shapes as they are of the common spherical and barrel circular varieties, but a solitary specimen from Stratum I, no. 125, has a bicone pentagonal shape, though much of its original shape has been lost due to corrosion. There is a striking predilection for large beads in Strata IX and VIII, and the tiniest spherical or oblate ones occur only in the upper strata.

All the beads are of opaque cane-glass and are fire-polished, the only exception being the bicone pentagonal bead, no. 125, which is a coiled bead. It is not possible to determine the colouring agent without analysis.

Nos. 124 and 125 (fig. 6 ; pl. XIII B)

124. Spherical. Wound on spoke.
No. 8948. AC III, KX/L1b, –65 ft. Stratum IX.

125. Bicone pentagonal. Wound on spoke. Corroded.
No. 4253. AC III, KIX/K8e, –42 ft. Stratum I.

J. Black-and-white glass

There are six beads in the collection in which a composite glass is used. This is done by two processes, (1) by adding an intermediate layer of white glass in between two strips of black (occasionally blue or violet) glass and by moulding them into the requisite shape, and (2) by twisting a number of canes of coloured glass into the requisite shape with an alternating band or bands of white introduced into the spirals at the time of finishing.

In the first process, the white band, which is homogeneous with the coloured glass, assumes the shape of an intervening layer and if the coloured glass is sufficiently transparent, the layer can be seen as if in an oblique cut well below the latter. In the second process the canes of white glass appear in the core in the form of an encrustation or appliqué work. Due to different coefficients of expansion this glass is liable to flake off and leaves a small depression or groove on the core. Many old specimens generally do not retain it. In the first process the moulded beads are often marvered, which is wrought with some difficulties in the second process.

Beads made by both the processes occur at Ahichchhatrā. There are two beads produced by the first process in which a white band is layered in between a bluish glass. These millifiori beads have been described earlier in the section on blue glass (above, p. 56).

There are four glass beads of the second process, with layers of black and white glass : all are done by spirally-wound canes. Two beads from AC III belong to Strata I and II and the other two are unstratified, though apparently of the same age as the former. It would thus appear that the process was introduced quite late in the history of glass-making at Ahichchhatrā. Of the first process there are several early examples, particularly from Taxila. I have not seen any example of the second variety in the excavated beads from Kauśāmbī.

Of these four beads, which are not illustrated here, one, belonging to Stratum II, is spherical in shape and is made of spiral glass by the wound process, with a white thread running on the core of the black glass which has partially flaked off. The second specimen, from Stratum I, is truncated bicone circular and is of black wound glass with a zonal appliqué white band in the centre. The third, from AC IV, MIX/H1f, -38 ft., is barrel circular in shape and is of black wound glass with three white spirals. The last, AC V, QVIII/P5h, -64 ft., is also barrel circular and is of a black wound glass with three spirals in white glass running from end to end on the core, leaving depressions in the flaked white portion.

17. BEADS OF COPPER

Only a few metal beads are known from Ahichchhatrā, all of them being of copper. Of the seven specimens here considered, four are from unstratified deposits, while the rest belong to Strata VIII to III. In spite of the small number there is an interesting variety in the shapes.

The oldest copper bead, no. 126, from Stratum VIII, is a small cylindrical tube fashioned out of a thin sheet of copper ; its overlapping end has not been soldered. Exactly identical beads of gold have been found in the megalithic burials at Brahmagiri,[1] and in the cists at Maula Ali in Hyderabad State. It is probable that these coiled objects were intended for ear-plugs and not beads.

The next in date is a small toggle-bead, no. 127, of unusual shape, being cylindrical with conical tops at either end. This specimen belongs to Stratum V. In the excavations at Śiśupālgarh large-sized terracotta ear-ornaments of this shape were found. Similar ear-ornaments are also to be seen amongst the sculptures at Amarāvatī and Nāgārjunakoṇḍa.

To Stratum III belongs a medium-sized spherical bead, about $\frac{1}{4}$ in. in diameter. To this class should be added two small oblate beads with annular holes, not accurately dated.

One of the beads, no. 128, from Stratum I, is small barrel bead shaped like a conch-shell. Half of the barrel is incised with a spiral line and in the other half a crossed line is drawn to indicate the columnar opening in imitation of a conch-shell. This shape is probably due to the sacred association of the conch-shell (*śaṅkha*) from very early times in India. As an auspicious object it is mentioned in early Indian literature like the epics[2] and was venerated alike by the Buddhists[3] and the Jainas. The *śaṅkha* was worn by

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[1] *Ancient India*, no. 4 (Delhi, 1947-48), pl. CXX B.

[2] *Mahābhārata*, Droṇa-parva, 82. 20; Varāhamihira's *Bṛihat-saṁhitā*, ed. H. Kern (Leyden, 1869), LXXX. 5, classes the conch-shell as one of the twentytwo gems.

[3] Cf. *Mahāvaṁsa*, XI. 30-31, *Dīpavaṁsa*, XI. 32-33.

perforating the shell itself[1] or by carving imitations thereof. Examples of the former type are known from Harappan sites and even from Taxila.[2]

Beads imitating conch-shells are common in terracotta and glass. For example, several terracotta beads have been found in Koṇḍāpur, and an analogous example is provided by a specimen from Bairant, preserved in the Bhārat Kalā Bhavan, Banaras. At Gayā Cunningham found two similar coral beads in the Mahābodhi temple.[3] At Maski there is a large number of black glass beads of the same shape. The Allahabad Museum also preserves a dark-blue glass bead of this type, said to have been obtained from Kauśāmbī. A few terracotta specimens, findspot unknown, are also in the author's collection. But the shape is very rare in metal : a gold specimen,[4] believed to be of Kushan or Gupta date, is known from Bhīṭā, while none of copper is known to me.

Of exceptional interest is a small unstratified copper bead, no. 129, shaped like a standing human figure, with its legs apart and feet joined together. The arms rest on the waist and the head is indicated by a small non-descript rounded projection above the neck. The lower extremities are shaped like a rhombus. A large perforation runs through the waist, probably for stringing with a series of similar beads. The figure exactly resembles some of the terracotta figurines from Ahichchhatrā, which are described as *vāmanaka* and attributed to Stratum IV.[5] On account of the striking resemblance of the copper bead with the dwarf figurines noted above, I am inclined to believe that it is of the same age as the figurines.

The exact purpose of this bead is not known, but some cult-significance is not unlikely.

Nos. 126-129 (fig. 6 ; pl. XIII B)

126. Long cylinder circular, fashioned out of a tube.
No. 8955. AC III, KIX/P9b, -61 ft. Stratum VIII.

127. Toggle-bead, cylindrical with conical ends.
No. 8742. AC III, KIX/P109, -52 ft. Stratum V.

128. Barrel, shaped like a conch-shell.
No. 4053. AC III, KIX/E2b, Room 128, Stratum I.

129. Bead shaped like a human figure.
No. 6587. AC V, QVIII/P4j, -73½ ft.

18. BEADS OF TERRACOTTA

Comparatively very few terracotta beads were unearthed at Ahichchhatrā. Besides some specimens occurring in different localities, the largest number was obtained in a room from Stratum III, assigned to the Gupta period. These beads, twentysix in number, are grey in colour and were baked very hard under a high temperature. While most of them are without any slip, a few bear a highly burnished black slip. They are the most

[1] The earliest use of a perforated shell as an ornament goes as far back as the Aurignacian period in France ; cf. specimen illustrated by H. Beck, ' Classification and nomenclature of beads and pendants ', *Archaeologia*, LXXVII (Oxford, 1928), fig. 25 A 4. Carnelian and other imitations are common in Egypt from the Vth Dynasty to Roman times. W. M. F. Petrie, *Amulets* (London, 1914), pp. 107-22.

[2] Beck, *Beads from Taxila*, pl. VIII, 41-42.

[3] A. Cunningham, *Mahābodhi* (London, 1892), pl. XXII, 28.

[4] *An. Rep. Arch. Surv. Ind.*, 1911-12 (Calcutta, 1915), pl. XXXII, 6.

[5] Agrawala, *op. cit.*, p. 118.

common forms of the arecanut-shaped beads, known from several sites in India, and are therefore without any interest. The arecanut is also the shape of two other beads from unstratified areas. The most popular shape at Ahichchhatrā seems to be the spherical one, which is represented by as many as twelve beads. All of them are of a pale yellowish colour of medium or fine-grained grits and are without slip of any kind. Only one specimen is of grey colour, similar to the number of arecanut-shaped beads referred to above. These are distributed mostly in Strata V to III.

The special forms are listed below.

Nos. 130-133 (fig. 6 ; pl. XIII B)

130. *Ghaṭa*-shaped with a collar at one end, annular. Such beads simulate the shape of pots with constricted neck and occur in all levels of Kauśāmbī (500 B.C. to A.D. 200), but are more common in the 100 B.C.-A.D. 100 levels, and at Bhīṭā, Chirayyā Koṭ, Ujjain, Masaon Ḍīh, Taxila, Peshawar and Tripurī, at the last place in about A.D. 200 levels.

No. 3169. AC V, QVIII/U9a, -63 ft.

131. *Ghaṭa*-shaped, but with a more globular and less squat body and a rounded collar. Fine-grained yellow colour with a yellow slip on exterior.

No. 10752. AC XV, PVIII/E6a, -61 ft.

132. Plano-convex circular with wheel-striations. Coarse fabric with a yellowish slip. A rare shape.

No. 6607. AC V, QVIII/P4j, -73 ft. 6 in.

133. *Āmalaka*-shaped. Of dark brown colour, well-fired. The shape is common at Koṇḍāpur, Kauśāmbī, Bhīṭā, Chirayyā Koṭ, Rājghāṭ, Masaon Ḍih, Azamgarh, Paiṭhaṇ, Arikameḍu (author's collection) and Tripurī (A.D. 200 levels).

No. 8014. AC IV, MIX/S9k, -42 ft.

STONE AGE INDUSTRIES NEAR GIDDALUR, DISTRICT KURNOOL

By K. V. Soundara Rajan

In 1949 *the Prehistoric Expedition led by Professor F. E. Zeuner of the Institute of Archaeology, University of London, visited, among other sites, those near about Giddalur, a town in Kurnool District in the northern part of Madras State. The author of this article, a member of the Expedition, describes here the implements collected from these sites at the time of the visit. It should be noted that more than two decades back the lithic industries of the same area were studied and reported on by Burkitt and Cammiade, who came to the conclusions that there had been a cycle of pluviation and interpluviation in the region that might correspond to the Himalayan cycle of glaciation and interglaciation and that typologically the tools had striking similarities with those from south Africa. Both these conclusions are of far-reaching significance, and any fresh light on the industries is therefore welcome.*

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1. INTRODUCTORY

THE potential importance of south India in the elucidation of the origin and movements of prehistoric cultures was brought out more than two decades back by the discovery of unknown Stone Age cultures in south-east India by Cammiade and Burkitt. Their work, published in 1930,[1] was based on observations made at a large number of sites in the region under study, though the tables of data produced by them

[1] M. C. Burkitt and L. A. Cammiade, 'Fresh light on the Stone Age of south-east India', *Antiquity*, September 1930, pp. 327-40.

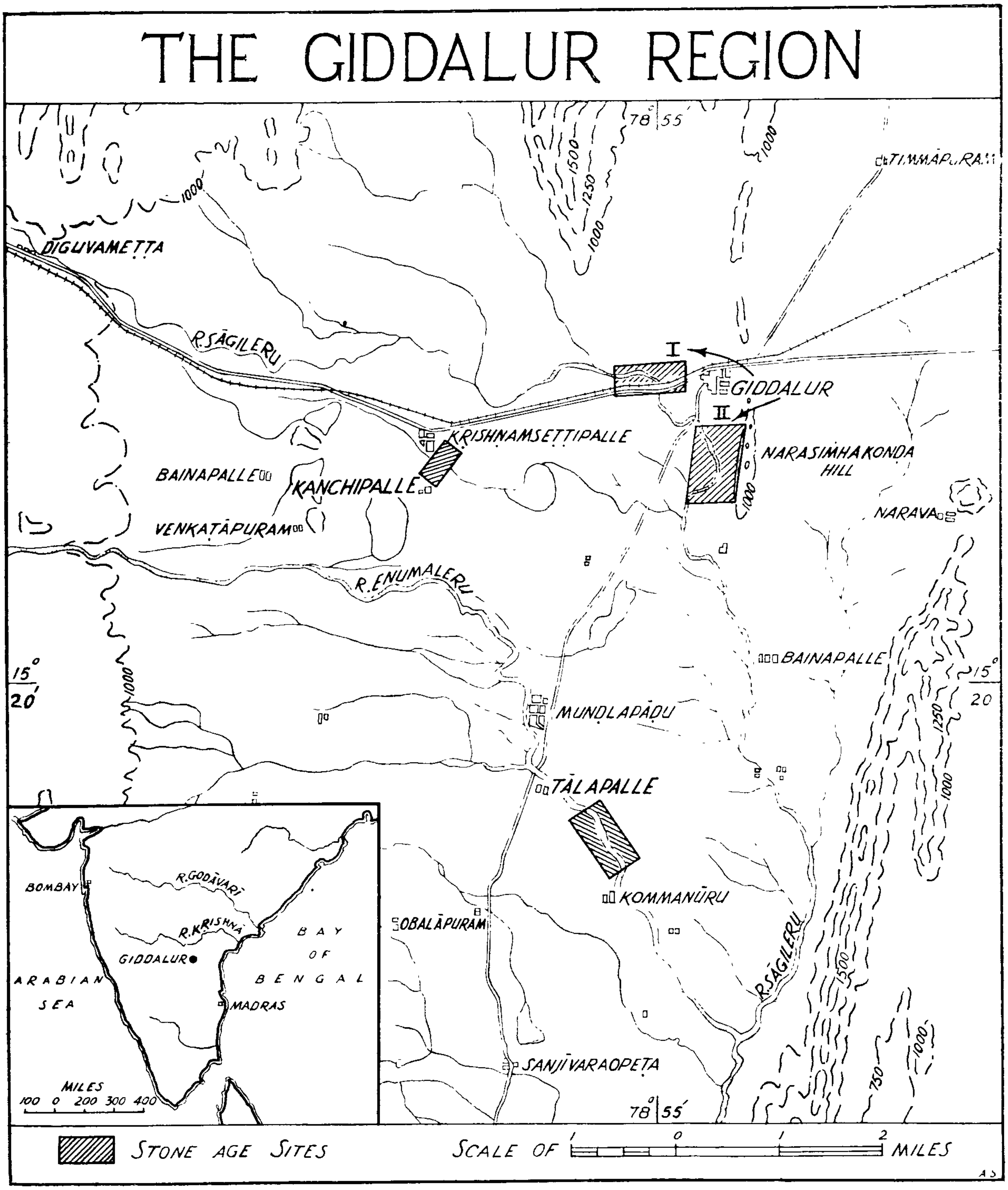
THE GIDDALUR REGION
78° 55'
1000
1500
1250
DIGUVAMETTA
R. SĀGILERU
I
II
GIDDALUR
KRISHNAMSETTIPALLE
NARASIMHAKONDA HILL
BAINAPALLE
KANCHIPALLE
VENKATĀPURAM
NARAVA
R. ENUMALERU
BAINAPALLE
15° 20'
MUNDLAPĀDU
TĀLAPALLE
KOMMANŪRU
OBALĀPURAM
R. SĀGILERU
SANJĪVARAOPETA
750
BOMBAY
R. GODĀVARI
R. KRISHNĀ
GIDDALUR
BAY OF BENGAL
ARABIAN SEA
MADRAS
MILES
100 0 200 300 400
STONE AGE SITES
SCALE OF 1 0 1 2 MILES

FIG. 1

were from some four or five selected areas viz. the Bhavanāśi gravels, where a good cliff-section was obtained opposite the village of Krishṇāpuram at the western entrances of the Dornālā-Atmakur pass of the Nallamalais ; Yerrakonḍapalem, near the eastern entrance of the same pass ; Gunḍla-Brahmeśvaram situated on the top of high mountain-valley on the bank of Gunḍlakamma river ; and Giddalur, a town near the Nandikanama pass, past which two rivers, Sāgileru and Enumaleru, flow and meet.[1]

This search, while bringing out four salient lithic cultures of different ages starting from the earliest handaxe industries of quartzite to the latest microlithic industry of agate and quartz, also revealed climatic changes characterizing the stratigraphic sequence represented at the different sites and their relationship with the changing tool-techniques and types involved in these industries and thus laid the foundation for the postulation of a pluvial cycle which was likely to have taken place in the Indian peninsula corresponding to the Himalayan glacial sequence demonstrated by De Terra and Paterson.

Further, the series of industries classified according to their technique and the *état physique* of the tools were shown by the authors to have almost similar counterparts in south Africa. Particularly a significant basis was found for a general correlation between the succession of climatic changes in these two widely separated areas. Thus, the alteration of pluvial and dry periods from the Early Palaeolithic times to the Mesolithic in both south-east India and south Africa appear to be strikingly similar as a result of these investigations.

This exploratory work was not followed up by a further examination of the problem until 1949, when the Prehistoric Expedition of the Department of Archaeology of the Government of India, led by Professor F. E. Zeuner, Geochronologist of the Institute of Archaeology, London University, and Shri V. D. Krishnaswami, was able to visit and study some of the sites mentioned by Cammiade. Among the sites visited were those around Giddalur, where a good collection of stone artefacts was made. While it will be too premature to dwell upon the climatological aspect of the problem in this area pending the report on the soil-examination and analysis by Professor Zeuner, a study of the general typological and technological characteristics of the recovered artefacts is recorded in the present paper by the author who collaborated in the expedition, and the palaeolithic and microlithic industries of the sites around Giddalur are discussed.

While Burkitt and Cammiade did not observe elements of their series III and IV around Giddalur, our collections do possess representatives of these two series also. The study of the tool-collection from these sites further indicates that while only series I and II of Burkitt and Cammiade are mainly found at Giddalur I, series III and IV are largely to be found at Giddalur II (Narasiṁhakonḍa), which has, however, a few elements of series I and II also. Excepting an Acheulian handaxe from the section in Giddalur II area (no. 23) and a parallelogram-sectioned cleaver of the Acheulian phase (no. 56) from the implementiferous zone of the Tālapalle section, the collection is all from the surface, either the river-bed or the top of the river-banks. At Kanchipalle and Tālapalle, the industries are representative mostly of series I, though the latter has a Middle Palaeolithic influence observable in its handaxe facies. Tools from both these sites are very heavily rolled.

2. PHYSIOGRAPHY AND GEOLOGY OF THE REGION

Two long ranges of hills, the Nallamalais on the east and the Erramalais on the west, divide Kurnool District north and south into three well-defined zones. The

[1] It is unfortunate that exact locations of Giddalur 'A', 'B' and 'C' have not been given by Burkitt and Cammiade in their article.

easternmost of these sections, which includes the taluks of Cumbum and Mārkāpur, is about 600 ft. above sea-level and is very hilly. Throughout the greater part of its length a range of hills known as the Velikoṇḍas, a part of the Eastern Ghats, divides it from Nellore. Between this range and the Nallamalais to the west several low parallel ridges cut up the country into valleys, and through these linear ridges the hill-streams draining the eastern slopes of the Nallamalais have forced their way. Some of these gorges thus hollowed have been dammed for irrigation. The most picturesque of these is the Cumbum tank formed by an embankment across the Guṇḍlakamma river. 'This fine sheet of water is about 5 miles long by 3 or 4 broad. It is nearly surrounded by picturesque hills and several rocky islets stud its bosom.'[1] This river cuts a huge gorge between Cholliveedu and Turimella.

The chief rivers among the eastern section of the district are the Guṇḍlakamma and its tributaries, the Rallavāgu, Tigaleru, Duvvaleru, Sāgileru etc., all rising in the Nallamalais. The Guṇḍlakamma has its source near Guṇḍla-Brahmeśvaram and enters the plain through the gorge of Cumbum. The Sāgileru flows south and drains the country towards the Pennar in Cuddappah District. It is this river that flows past Giddalur town and has a tributary Enumaleru joining it near Tālapalle.

Geologically, Kurnool occupies the centre of a basin consisting of two great Azoic formations, namely, the Cuddappah and Kurnool systems, the latter series resting unconformably on the upturned edges of the former series. The eastern section, of which the country around Giddalur is a part, belongs to the Nallamalai quartzites. The central part belongs to the latter (Kurnool) system characterized by limestones and quartzites. The westernmost part belongs partly to the Cuddappah and partly, along the extreme west, to Archaean formations consisting of granitic rocks of no particular interest.

There is an intercalation of shales and quartzites[2] in parts of the middle and eastern section of the Kurnool area. The Sāgileru plain, however, is occupied entirely by the middle Nallamalai (Cumbum) shales underlain by Viramkoṇḍa (Byrenkonda) quartzites. The Sāgileru shales are often quartzitic and more whitish or ash-coloured than those further north, which are grey or purple. They are highly cleaved oblique to the bedding planes and weathered along the cleavages into silvery platy bits.

3. THE SITES AND THEIR STRATIGRAPHY

A. GIDDALUR I

The cliff-section in the Sāgileru river by the bridge near Giddalur was the first site examined. This and the following two sites together will be called as Giddalur I in this paper. Here the river meanders, and where it strikes the opposite bank after swinging the section revealed above the water-level (in March) is basal weathered rock, upon which is a deposit of cemented gravel overlain by a layer of river-silt, and this again is superimposed by a loose pebbly deposition of a comparatively much later origin. The entire cliff is only 10 ft. high.

[1] T. J. Newbold, in *Jour. Asiatic Soc. Beng.*, XV (1846), p. 392.

[2] There is an interesting occurrence, a mile east-north-east of Sanjīvaraopeṭa on the Giddalur-Cuddapah high road, of a N.W.-S.E. linear tract of country covered by a layer of rounded pebbles and blocks of quartzite and sand about 6 ft. thick above the Nallamalai shales. It was also revealed in a well-section west of Igvannapalle. 'Geology of parts of Kurnool and Cuddapah Districts', *Geological Survey of India, Progress Report for* 1949-50 (Sept. 1951).

South of the S.P.G. mission bungalow in Giddalur town on the Sāgileru the river-section shows gravel in a highly cemented condition lying in between the bed-rock and modern flood-loam (pl. XV A). The cliff is about 10-12 ft. above water-level, and on the top are observed a scatter of small chips of quartz and chert among which occur microlithic flakes.

Between the 80th and 81st mile-stone on the Giddalur road, north of the railway line and between the road and river Sāgileru, the high ground above the bridge-section contains a dense and extensive scatter of pebbly gravel lying in the undulations. A good number of handaxes, cleavers and flakes was picked up here.

The occurrence of a consolidated gravel-bed in the lower levels and of a loose gravel-bed capping the sections on the high ground mentioned above may probably be indicative of two aggradational phases, and the phase of loamy sand in between may mean an arid condition, even though the coarse loose top-gravel phase may itself be regarded as an evidence of a comparatively dry condition, perhaps much less arid than the preceding sand-phase. This would suggest a progressively warmer climatic condition. The shaley bed-rock is, in its upper part, in a cleaved and weathered state, and its lower parts comprise a good laminated shale. Further, where the lower gravel-bed is found resting on the bed-rock itself, it is clear that the aggradation-cycle must have started while the river was flowing on the rock-bench.

B. GIDDALUR II

About a mile south and south-east of Giddalur town, near Narasiṁhakoṇḍa, is another site (indicated as Giddalur II), where also the section of the Sāgileru and its gullies contain the gravel-stratum. The implements were, however, found generally on the surface above the section. Near about this place but in greater frequency at the foot of the hill immediately to the east and again on the surface were picked up microlithic artefacts, some of indisputable shapes and appearance (below, p. 89).[1]

C. TĀLAPALLE

Near Tālapalle village, about 5 miles south-west of Giddalur, a stretch of about a furlong of the river Enumaleru was studied. In the first section nearest to the village it is a very low cliff, not higher than 5 ft., the lower part of which is a pebbly layer, and the upper part consists of recent flood-loams (pl. XV B). At this place the flood-plain terrace in the bed is entirely covered with a dense gravel-spread teeming with implements mostly rolled. They contain essentially series I tools and seem to come down from heights during a pluvial phase, carried down and deposited as detrital pebble-beds devoid of stratification. Farther away from the village, where there is a swing of the river, the cliff-section is a well-stratified deposit as much as 20 ft. thick. The cemented gravel-layer here is of a thickness of 6 ft., in which a good large-sized cleaver of parallelogram cross-section and pebble-butt (no. 56) was noticed *in situ*.

The sequence of deposits from top to bottom is as follows :—modern flood-loam, about 5 ft. thick, underlain by reddish earth with kankar-deposit, which immediately overlies the cemented implement-bearing gravel-bed, itself resting upon the basal shaley rock exposed to a height of 4 ft. above the then water-level and having a marked obliquity towards the east.

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[1]This Giddalur II area deserves a more intensive study for a greater clarification of stratigraphical and climatological data.

D. Kanchipalle

Three miles west of Giddalur and about half-a-mile south of Krishṇamseṭṭipalle is the site Kanchipalle marked by a gully probably pertaining to the Enumaleru river. The gully is full of huge rolled pebbles and flakes essentially of Clactonian technique. A few Abbevillean-looking tools with pebble-butt and one good Acheulian pyriform handaxe were noticed among the pebble-scatter there. There is no section available at the gully, and a well-section nearby reveals only soil over shales.

4. TYPOLOGY OF THE PALAEOLITHIC INDUSTRIES

A. Giddalur I

The collection made from the site Giddalur I contains essentially tools belonging to the series I and II of the classification of Cammiade and Burkitt. But at the same time one can divide them on the basis of *état physique* as well, and it is noticed that almost invariably the earlier tools such as the Abbevilleo-Acheulian handaxes and the rostrocarinates are more rolled than the evolved Acheulian coups-de-poing and cleavers and other flake tools. One of the important features noticed in the collection is the occurrence of the rostrocarinate and 'Victoria West' forms (nos. 1 and 2 respectively) among the specimens of the earlier series. These implements, made out of pebbles, as is very apparent by the cortical patches often preserved on them, have been boldly flaked and have irregular rims. The rostrocarinates particularly are of the largest size (8 in. to 10 in. in length and 4 in. to 6 in. in width) and have a flat ventral plane and a keel-like dorsal surface with a high cortical-patched butt-end. These features were noticed by Mr. Burkitt here as well as at Choḍavaram. The Victoria West type, which assumes its name from its having been first noticed at Victoria West in South Africa, has the special feature in the ventral surface being formed almost entirely by the removal of one single flake and the tool having a pointed end. Owing to the first-mentioned feature the tool has a mildly crooked tip-end also. The occurrence of this type in south-east India is considered by Burkitt as of extreme importance and as a sure indication of the connexion existing between this region and south Africa. In south Africa this tool, though Lower Palaeolithic in date, is connected with the first appearance of flake industries.

Pebble choppers with both unifacial and bifacial flaking are also present. While at Giddalur I they are mostly on irregular and full pebbles recalling the Kafuan or Oldowan counterparts, at Giddalur II they are made often on split pebbles and resemble closely the Sohan pebble chopper-chopping tools of north-west India. It would indeed be interesting to ascertain the technological 'increment' in these two pebble tool-types in the Abbevilleo-Acheulian assemblage in this area from collections made *in situ*. At the same time, their low percentage compared with the prolific variety of biface cleaver forms in the industry might suggest the pebble-element as an autochthonous and integral part of the main core-tool tradition of the south.

There is a good representation of Abbevilleo-Acheulian tools which are characterized by irregular or wavy margins, remnants of cortical patch in the butt-end in many cases and an almost elliptical cross-section. Often both the dorsal and ventral sides have a mid-rib, but in almost all the cases the tip is pointed. A majority in this group is in a much rolled condition.

The next important group consists of ovoid tools (nos. 10 and 11) and flake-made handaxes (e.g. no. 7), presumably of the middle to late Acheulian period. The ovoids range from narrow and elongated specimens with jagged rims and elliptical cross-sections

to those which are very wide and almost discoid in shape with fairly well-chipped sides, straight rims and lenticular cross-section. The handaxes include extensively chipped pear-shaped specimens (nos. 8 and 9), the tips of which are sharp and pointed and which have a biconvex cross-section. These have a comparatively much fresher look than the Abbevilleo-Acheulian group mentioned above and are much lighter in weight and more regular in shape. There are also two broad-ended handaxes (e.g. no. 12) which would have to be ascribed technically to this group and which form, as it were, the transition-group between handaxes and cleavers in the middle Acheulian period. These have a thick pronounced butt-end and narrowing body, ending, however, in a narrow cleaver-like straight edge.

There is a fine group of cleavers which either are ordinary bifacially-chipped ones (e.g. no. 13)—the descendants of the two specimens mentioned above—or are the results of single Vaal technique of cleaver-edge-making with a rather squat, almost semi-circular shape (e.g. no. 14), or of the double Vaal technique with parallelogram cross-section. Among the last-mentioned group there is one tool (no. 15) which is a text-book specimen, as it were, of the double Vaal technique, owing to its most carefully chipped margins containing the flake-scars on either side and a most regular parallelogram cross-section and a cleaver-edge obtained as a result thereof.

The advanced Acheulian coups-de-poing are represented by a group of four specimens (e.g. nos. 8 and 9), which are extensively chipped on both sides and are of a regular shape with a pointed tip and biconvex cross-section. One of these (no. 9), though well-made, is of small size.

As far as our collection goes, Giddalur I does not have any Levallois flakes. The flakes are all Clactonian in technique and range from large and oblong ones with a smoother ventral flake-side, a prominent bulb and occasional ripples to a few small ones which are roughly triangular in shape and have been the result of either straight hits on top or oblique hits from across the sides. Some of the flakes have a serrated edge perhaps denoting use, and one of them has got a wide notch on the side which may indicate its having been used as a hollow scraper also.

The cores are all Clactonian cores, largely of the biconical or discoidal types (e.g. no. 16) of medium to small sizes. Among them are two scrapers (nos. 17 and 18), both of them of the hollow scraper variety, with the functional notch much battered probably due to utilization.

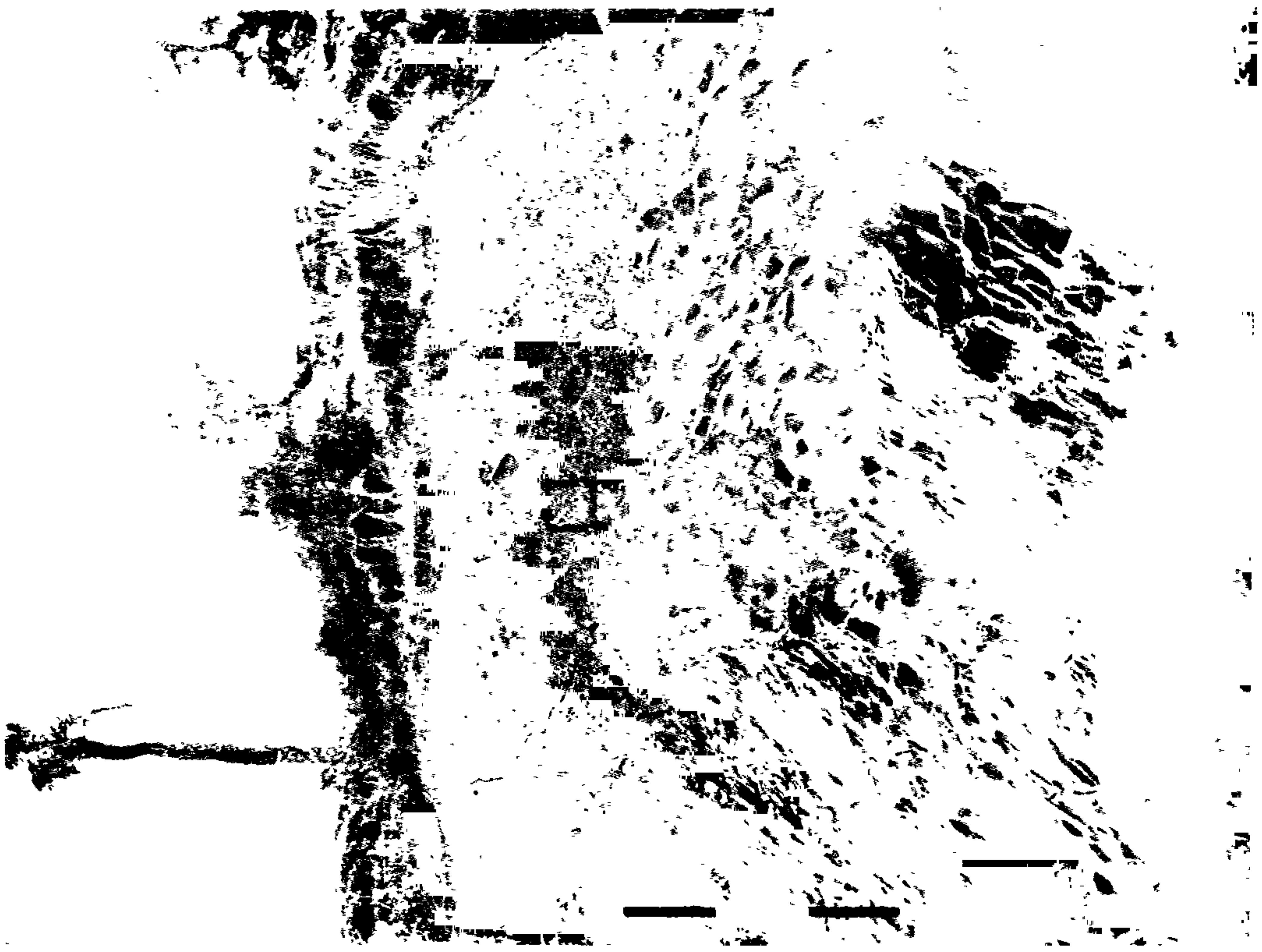
The rest of the collection consists largely of a miscellaneous group of waste flakes and rejects discarded during the process of the fabrication of actual tools.

There is one single specimen of a bladish flake on greenish quartzite of plano-convex section with flat underside and parallel margins. It is either broken or was deliberately truncated, as the bulbar and the tip portions are absent. This should actually belong typologically to the series III of Burkitt, and it has probably strayed into the Giddalur I site by accident and thus may have nothing to do with series I of this site.

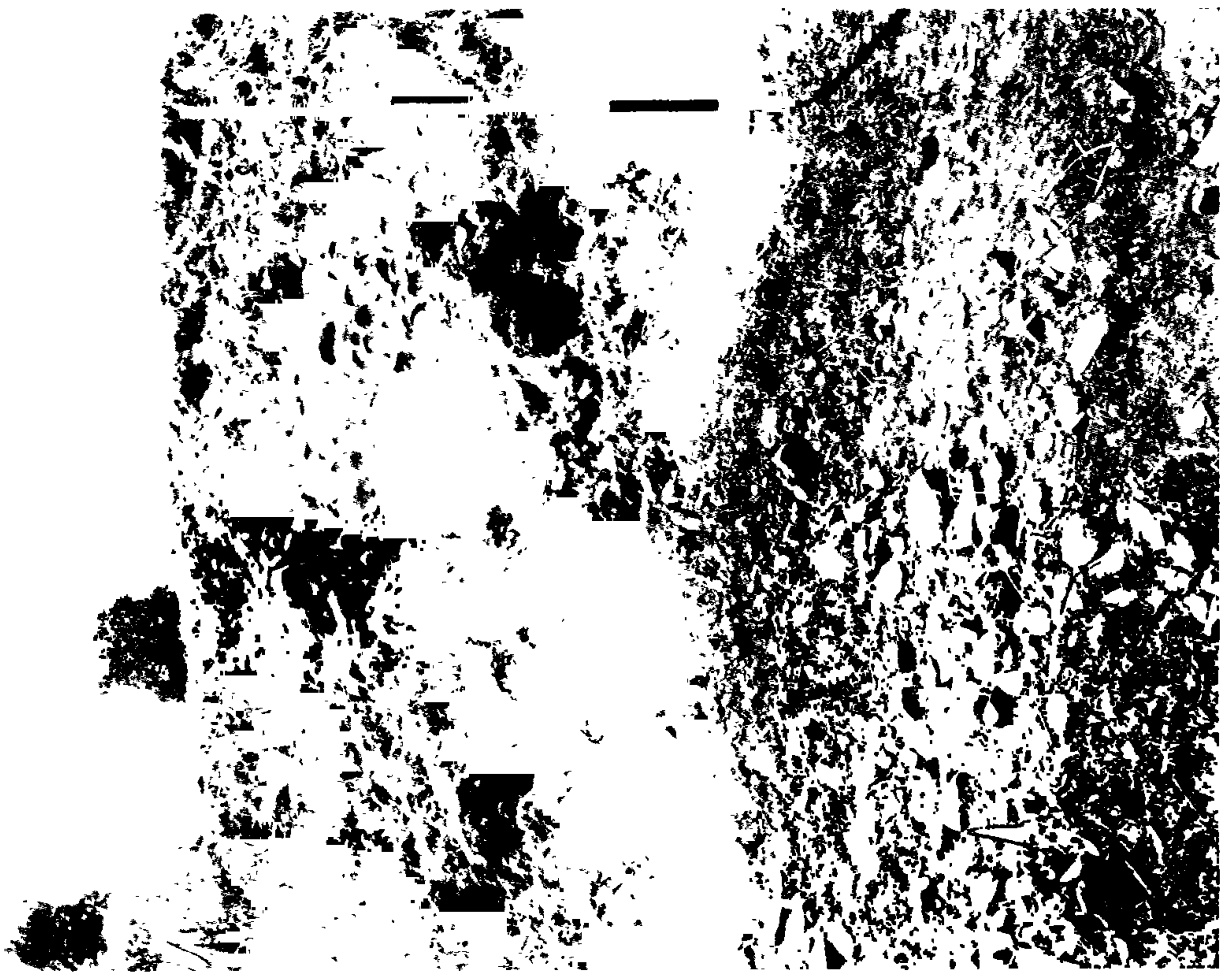
It is apparent from the composition of the collection that the prominent groups in this site would be those of the Abbevilleo-Acheulian bifacial industry with a pebble-tool accompaniment and a Clactonian flake-technique.

B. Giddalur II

While in the collections from Giddalur II also the tools of the Abbevilleo-Acheulian facies are represented, it must be mentioned that the tools are all comparatively smaller in size, rostrocarinates and Victoria West types are absent and a certain proto-Levallois and Levallois trend in flake-making is present, which shows an advanced industry. A



B. *Artefact-bearing gravel-section on the Ennamaleru river near Tālapalle* (*see page* 68)



A. *Artefact-bearing gravel-section near S.P.G. Mission on the Sāgileru river, Giddalur I* (*see page* 67)

Palaeoliths from Giddalur I: handaxes and pebble tools

feebly represented group of coarse burinate flakes, three in number (e.g. nos. 36 and 37), and another better represented group of blade tools and bladish flakes, five in number (e.g. nos. 38-40), would seem to accentuate, from the typological point of view, the development noticeable in the industry. Most of the flakes (Clactonian and Levallois) and the scrapers are quite small and would seem, on the whole, to be part of an Upper Palaeolithic tool-assemblage. Levallois and proto-Levallois flakes together almost equal the Clactonish flakes. Even of the cores a majority is of less than average size of a normal residual core of a Lower Palaeolithic industry.

This would mean that in Giddalur II site we have an industry essentially pertaining to the series II and III of Burkitt and Cammiade along with representatives of series I. As will be seen (below, p. 89), series IV also forms a distinctly prolific group at and near Giddalur II site. The view expressed by the scholars mentioned above (p. 66) that when admixtures from series II and IV are eliminated series III industry appears very poor, while series IV industries are individually rich, seems to some extent to be corroborated by the collections under review, even though the blade-element seems to have been sufficiently represented in our collection.

While the industries of series I of Giddalur I are very much rolled, the corresponding artefacts in Giddalur II appear to be comparatively more fresh-looking. This may imply that the earlier facies of Giddalur II would belong typologically to the end of series I and the beginning of series II, as further suggested by their much smaller size and better workmanship. Of the eight tools in the Acheulian group in Giddalur II, three (e.g. no. 24) are made on flakes ; and of these one (no. 26, unfortunately half-broken) is of a very thin cross-section and would seem to possess an 'S'-twist. Of the rest one has a broad cleaverish end, while most others (e.g. no. 35) have tongue-shaped ends. Of the four cleavers, two (e.g. no. 27) are made on flakes and have a straight edge formed by a single Vaal blow ; of the other two, one has an oblique cutting-edge, and the second (no. 28) is an exquisitely made triangular-shaped cleaver having a fine parallelogram cross-section, obtained by double Vaal blows and exhibiting a fine secondary trimming ; the cleaver-edge appears to be worn out by utilization.

It is possible to classify the flakes and flake tools into two clear groups on the basis of size, material and workmanship. Thus, those of series II are made of the same brownish quartzite like the mass of the handaxes and are invariably bigger in size without much of secondary trimming in most cases ; the other group consists of tools smaller in size and is made on greenish shaley variety or on lydianite. These tools are either slender blades with backing on one side or side- and end-scrapers with steep secondary retouch along the working-edges. While Levalloisean technique is apparent on many of these (e.g. nos. 29-33), there seems to be indications of punch-technique also, as is seen from the long slender slices removed from the surfaces of some of the flakes. There are, besides, five specimens (e.g. nos. 34 and 38-40) of what must be called bladish flakes. A few coarse burinate tools available would also belong typologically to this series III.

C. Tālapalle

The collections from the Enumaleru river-bed near Tālapalle have in the main Abbevilleo-Acheulian characteristics, and the tools are large-sized and boldy flaked with very little of stepped flaking perceivable. The material is almost entirely of quartzite, save for a few specimens which are of sandstone, probably quartzite metamorphosed due to long weathering. The entire bed was scattered with pebbles and artefacts, and except some of the flake implements all the tools in the collections are heavily rolled. There is one large-sized pebble chopper much rolled with jagged edge along a part of the periphery.

One of the Abbevillean handaxes (no. 48) is made from a very large-sized pebble about 9 in. long and 6 in. wide and is worked with bold flakes with deep scars bifacially with a resultant rhomboid cross-section owing to the mid-rib on either side.

Side by side with Abbevilleo-Acheulian bifacial handaxes with or without pebble-butt there is also a persistent element of flake-made handaxes (e.g. no. 51) fabricated on large-sized flakes and with their upper part only slightly trimmed into a handaxe shape. There is a feeble representation of Victoria West type (e.g. no. 54). The Abbevillean series alone manifests the gradual development in itself. There are tools with pebble-butt and only ends slightly flaked into a sharp point. There are others (e.g. no. 50) which have an almost lanceolate upper part and lower pebble-butt, and again we have those (e.g. no. 49) which have a narrow cutting-edge rather than a tip-end with rough parallelogram cross-section and thus stand technically in between bifacial handaxes and cleavers. There are a few ovoids (e.g. no. 53), some of which have a laterally inverted 'S'-twist along the sides. Rolled and unrolled cleavers of both ordinary bifacial flake-technique as well as Vaal technique are found. One of these (no. 56), picked up *in situ* from the implementiferous gravel-stratum in the cliff-section of 20 ft. height mentioned above (p. 68), is a boldy flaked tool with neat double Vaal blows resulting in a sharp cleaver-edge and a parallelogram cross-section ; it has a pebble butt.

The flake tools include fairly retouched side-scrapers and two good specimens of the hollow scrapers (e.g. no. 57), spoke-shaves as van Riet Lowe calls them, and the flakes are big and small, discoid and tongue-shaped. One of the flakes (no. 59), which is of a triangular shape with retouched edges, appears to have the platform somewhat prepared though still obtuse-angled. There is one flake tool (no. 60) in which both the upper and the lower sides are formed by major flake-scars with a positive and negative bulb, and thus it is of a concavo-convex section and with a plain striking-platform. The broad edges at the lower part of the flake have been worked by secondary retouch into a useful scraper.[1] This specimen may very reasonably be a precursor of the true Mousterian and would be placed typologically in a Middle Palaeolithic industry.

Mention has been made of the emphatic presence of handaxe-like tools which have on the underside the flake-scars and the bulbs. This would indicate that the Tālapalle industry is a mixed one because this feature demonstrates a Middle Palaeolithic influence acting on a Lower Palaeolithic industry. In the present state of our knowledge we are not able to fix the relative age of these tools in comparison to other truly Lower Palaeolithic Abbevilleo-Acheulian tools. The south African counterparts to these types and particularly flake-made tools are found at Middledrift (Cape Province) in Stellenbosch industry at Cofimvaba (Transkeii) and near Process Bridge in Orange Free State. These have been shown to belong to the Middle Palaeolithic by the evidence from Taungs, where clear stratigraphical superposition reveals the following sequence : Lower Palaeolithic, Middle Palaeolithic and Smithfield. The occurrence of similar specimens in our collection, unduly rolled and in most cases with pebble-cortex and with the upper side not showing very neat trimming, would show that here it is the influence of a Middle Palaeolithic industry on the Lower rather than the presence of a Middle Palaeolithic industry itself.

This element in the Tālapalle industry together with the concavo-convex flake scraper and the Levallois-like flake tool would tend to place it in the stage which would mark the end of series I and the beginning of series II.

[1] While this would appear to have its analogies in the south African Smithfield A tool-type, it cannot belong to that industry which is much more modern than the main industries we are dealing with here and which, as Burkitt feels, is an autochthonous growth with a restricted distribution in south Africa and the result of a contact between the Fauresmith and the Wilton cultures.

D. Kanchipalle

The Kanchipalle industry essentially comprises series I. Abbevillean handaxe-like tools and large-sized Clactonian tools, both of them heavily rolled and both retaining for the greater part of the body the cortical patch, form the chief features. The cores are also rolled and Clactonish. Nevertheless, truly Acheulian feature is present in the industry as represented by one single regular Acheulian pyriform handaxe (no. 62) bifacially chipped with secondary trimming along the edges and biconvex cross-section, though with a flattish cortical butt-end. There are also among the flakes a few which have the cortical patch non-existent owing to the primary or secondary preparation. The entire gully-site is littered with large heavily rolled pebble artefacts and flakes of the Abbevilleo-Acheulian facies. Its rolling is perhaps due to its transport from higher regions down into shallow shingle-beds. It is this earlier bifacial industry that again forms a prominent feature of the dense pebble deposit found in the bed of the rivers themselves, as near Tālapalle on the Enumaleru.

Representative tools from each of the four sites are described below.

Inventory of palaeolithic tools from the four Giddalur sites

Types	Sites			
	Giddalur I	Giddalur II	Tālapalle	Kanchipalle
Pebble tools	2	3	1	...
Rostrocarinates	2	...	...	...
Victoria West	2	...	1	...
Abbevilleo-Acheulian handaxes ...	13	6	9	3
Acheulian handaxes	19	8	13	1
Ovoids	14	...	7	...
Cleavers	6	4	5	12
Clactonian flakes and flake scrapers ...	11	30	10	...
Proto-Levallois	...	10	2	...
Levallois	...	14	...	...
Bladish flakes	1(?)	5	...	...
Coarse burinate tools	...	3	...	...
Cores and core scrapers	10	7	3	3
Total	80	90	51	19

Waste flakes excluded.

5. DESCRIPTION OF THE PALAEOLITHIC TOOL-TYPES

A. Giddalur I

(i). *Handaxes and pebble tools* (figs. 2 and 3 ; pls. XVI and XVII)

1. This is a good specimen of a rostrocarinate about 8 in. long, the underside of which has a flat surface formed entirely by a single flake-scar and the upper side of which is made into a pointed end by bold bilateral scars resulting in a middle ridge or keel with a hump formed at the butt-end retaining the cortical patch. There is no secondary working. Burkitt refers to good examples of this type.

2. This is a specimen exhibiting the Victoria West technique, made on a medium-sized ovoid pebble. Its upper side has a cortical butt-end and flaking around the rest of the periphery, ending in a slightly curved though pointed tip. A big flake removed by a knock from across the right side formed the major part of the ventral side. It is this big flake-scar which has given the crooked tip to the tool. Burkitt has mentioned good specimens of Victoria West types similar to this one in his collection, but, while in his specimens the bulbar scar is on the left margin of the ventral side, in the specimens in our collection it is on the right margin.

3. A pebble chopper on a weathered quartzitic pebble with bifacial chipping resulting in a more or less straight edge across. The edge shows signs of use.

4. A handaxe made on weathered ovoidal quartzitic pebble, the lower part of which is almost entirely made up of the cortical portion on both sides and the bold bifacial chipping along the rest of the periphery has resulted in a wavy cutting-edge and median ridge ending in a fairly pointed tip.

5. A handaxe made on a medium-sized flattish greenish quartzite. The ventral side is fully flaked and the dorsal side has peripheral flaking and retains a weathered cortical patch on it. It has a meagre pebble butt. Secondary chipping along the periphery has resulted in a more or less straight cutting-edge. It has a sharp and wide working-end.

6. A medium-sized Acheulian core handaxe on greenish quartzite with bifacial primary and secondary flaking and a sharp tip. The tip-end exhibits the same alternate removal of flakes on opposite sides.

7. Acheulian handaxe on a flake with a flattish and thick butt-end, fairly sharp and straight sides and tapering tip. It exhibits bold flake-scars on the body as well as stepped flaking along the periphery.

8. Finished advanced Acheulian coup-de-poing with the ventral side produced largely by a single flake-scar, which has mostly been removed by secondary stepped flaking, with an elongated tip.

9. Diminutive Acheulian handaxe in greenish quartzite with straight sides and pointed tip. Stepped flaking apparent all round the edges.

(ii). *Ovates* (fig. 3 ; pl. XVII)

10. Finished ovoid exhibiting single Vaal flake-scar on the ventral side, though secondarily chipped and hence belonging to the middle Acheulian. The tapering end is thicker than the broad end, and it is this which prevents its being classified as a handaxe.

11. Another finished ovate tool with both surfaces extensively chipped and the edges also worked by secondary stepped flaking to produce a straight periphery and thus having a broad biconvex cross-section. This must belong typologically to the middle-late Acheulian bifacial culture.

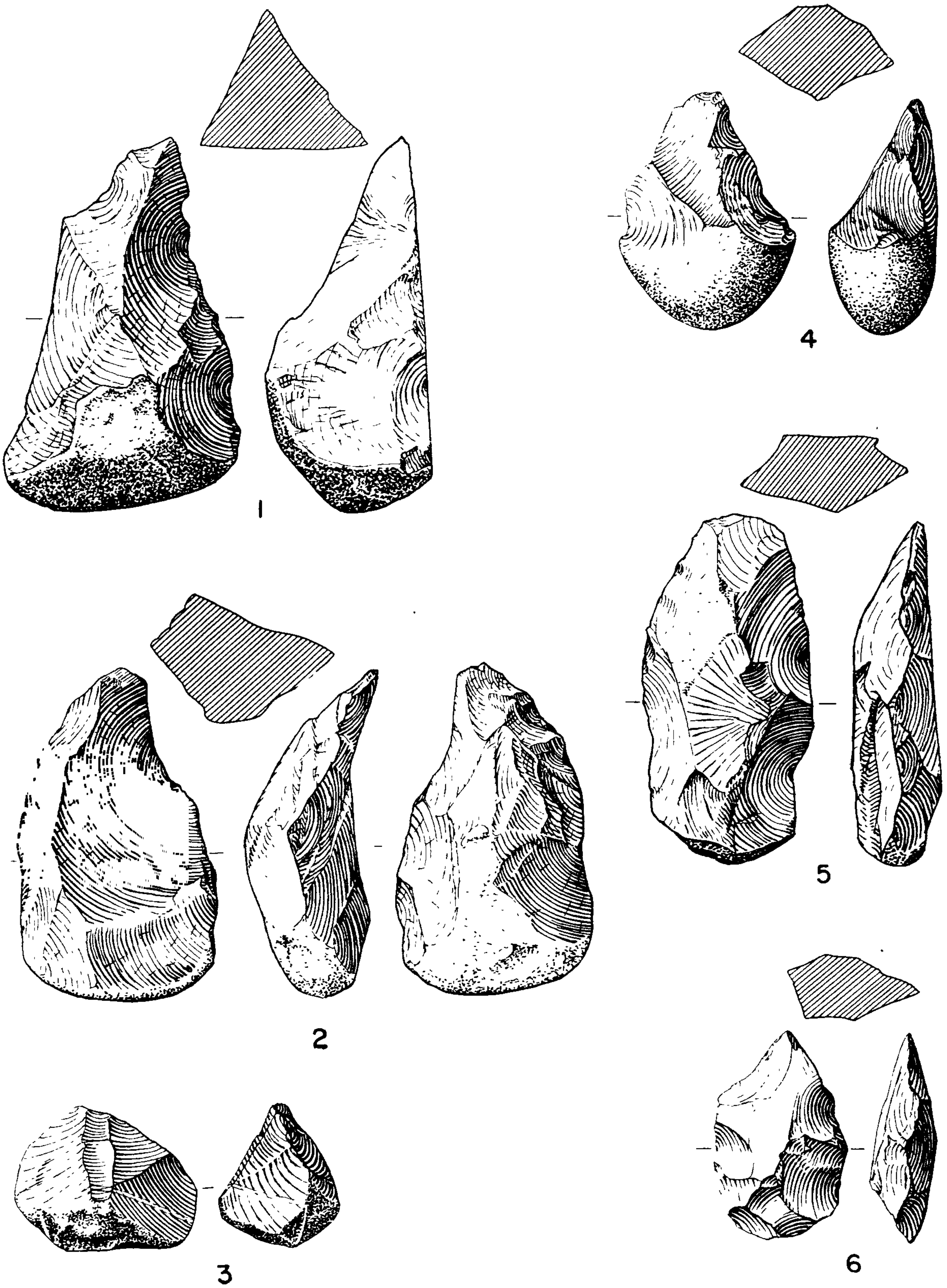


FIG. 2. *Palaeoliths from Giddalur I : handaxes and pebble tools.* $\frac{1}{3}$

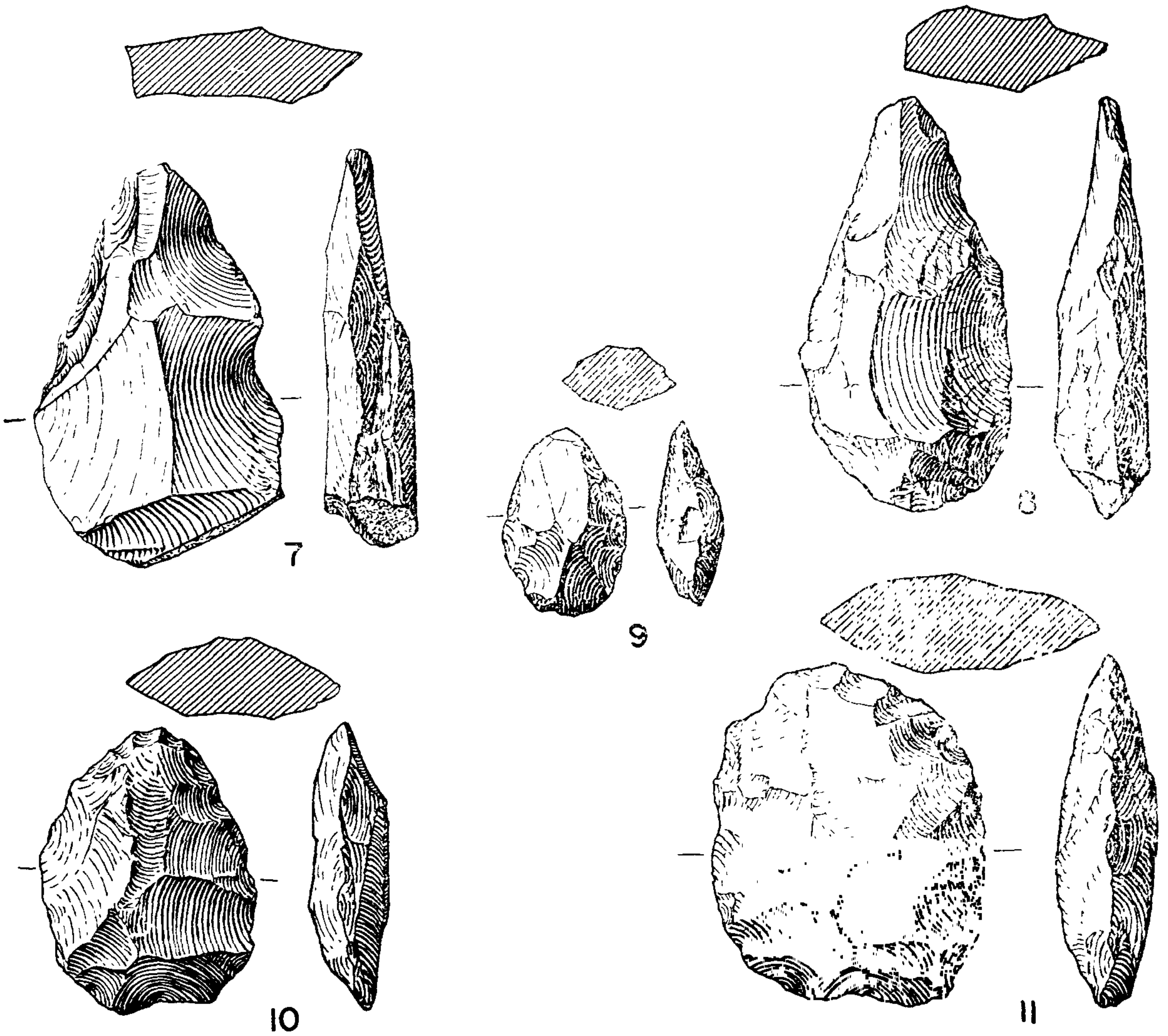


Fig. 3. *Palaeoliths from Giddalur I : 7-9, handaxes; 10 and 11, ovates.* $\frac{1}{3}$

(iii). *Cleavers* (fig. 4 ; pls. XVII and XVIII)

12. This tool represents the transition between the bifacial handaxe and the cleaver. It has the general appearance of a handaxe but has a broadish edge at the bottom instead of a tip, and this edge is formed by a blow from the lower part of one of the edges, which would detach one single flake across resulting in the edge. In other words, it is the forerunner of the cleavers made by the Vaal technique. On the dorsal side there is a mid-rib in the lower part, and thus the cross-section of the lower part of the tool is a parallelogram. The butt-end retains a meagre cortical patch.

13. This represents one of the three types of cleavers available at Giddalur, the other two being represented by the two succeeding specimens. Its dorsal side is extensively chipped and has thicker upper portion and the edges show stepped flaking. The ventral side has a large unique flake-scar almost all over the side by a blow from the right-hand edge, the bulb of which, together with the upper edge, has been removed by secondary flaking. Thus it has a broad and sharp cleaver-edge. On the whole it is made by a technique

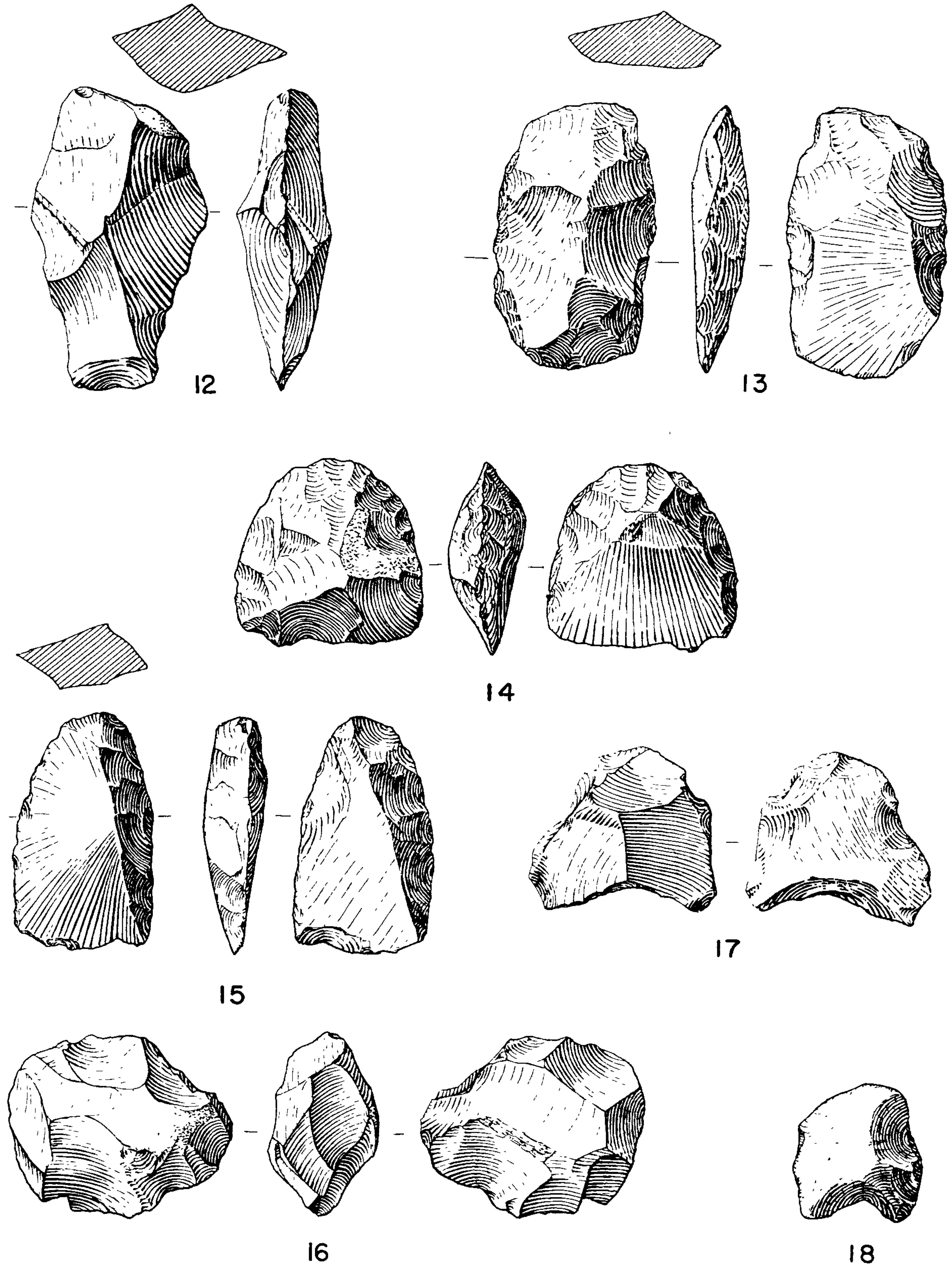


FIG. 4. *Palaeoliths from Giddalur I :* 12-15, *cleavers;* 16, *core;* 17 *and* 18, *core scrapers.* $\frac{1}{3}$

similar to that of the coup-de-poing. There is a corresponding type of tool distinguishing the Stellenbosch industries of South Africa, and similar examples can be seen in the tools from Villiersdrop and Middle drift, as illustrated by Burkitt.

14. This is a Vaal or Pniel river variant of the cleaver technique. It is, however, a squat and horseshoe-shaped tool with a beautifully chipped dorsal side. The lower part of the ventral side is a smooth single flake surface formed by a blow from the side. The thick butt-end has been neatly trimmed in a curved fashion on the ventral side by secondary working. The dorsal side has meagre cortical patches in the upper part. The broad cleaver-edge is serrated probably due to use.

15. This is one of the most exquisite cleavers ever to be picked up and is a veritable text-book specimen of an ideal double Vaal cleaver. Either side has a smooth triangular flake-surface with controlled marginal reversed flaking, so much so that the cross-section of the tool at any place is a parallelogram. The cleaver-edge is battered due to use.

(iv). *Core and core-scrapers* (fig. 4 ; pl. XVIII)

16. This is a discoidal Clactonian core which has an equatorial jagged edge owing to the removal of alternate flakes, the upper side having a cortical patch in the middle.

17. This is a hollow scraper on a core. The broad upper edge has a functional notch and battering due to use. The rest of the margin also shows secondary working for a scraper-edge.

18. This is another hollow scraper on a core but with a much narrower notched scraper-edge. It is of pinkish brown quartzite almost metamorphosed into sandstone.

B. Giddalur II

(i). *Pebble tools and handaxes* (fig. 5; pl. XIX)

19. This is a chopper on a round pebble which has just a flattish cortical patch at the base for grip and the rest is bifacially chipped extensively so as to form a straight cutting-edge constituting a major arc of a circle. The flakes have all been removed from the cutting-edge in a direction away from it. The material is brown quartzite.

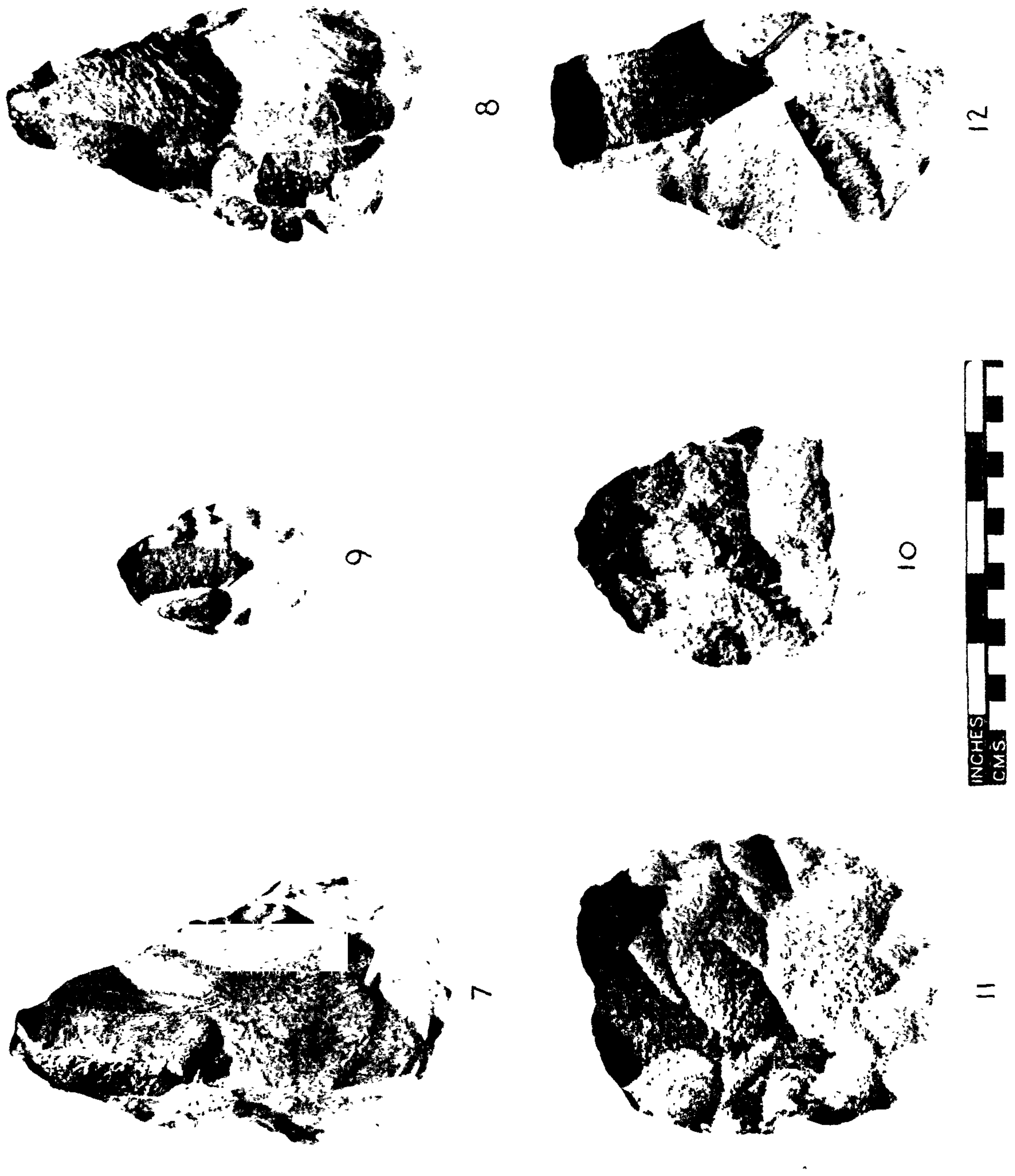
20. This is a split-pebble chopping tool strongly reminiscent of its Sohan counterpart, which has a flattish underside formed of negative bulbs all around the periphery and the dorsal periphery also chipped with secondary trimming into an effective working-edge with the central part of the tool flattish. The material is brownish quartzite.

21. This is a bifacially chipped handaxe with a pebble butt, which has on one of the sides a major flake-scar (though not very large or deep) removed from across the left margin and is the one nearest in approach to the Victoria West type, though not a typical one, in the industries from Giddalur II. It is made on reddish brown quartzite, almost changed into sandstone.

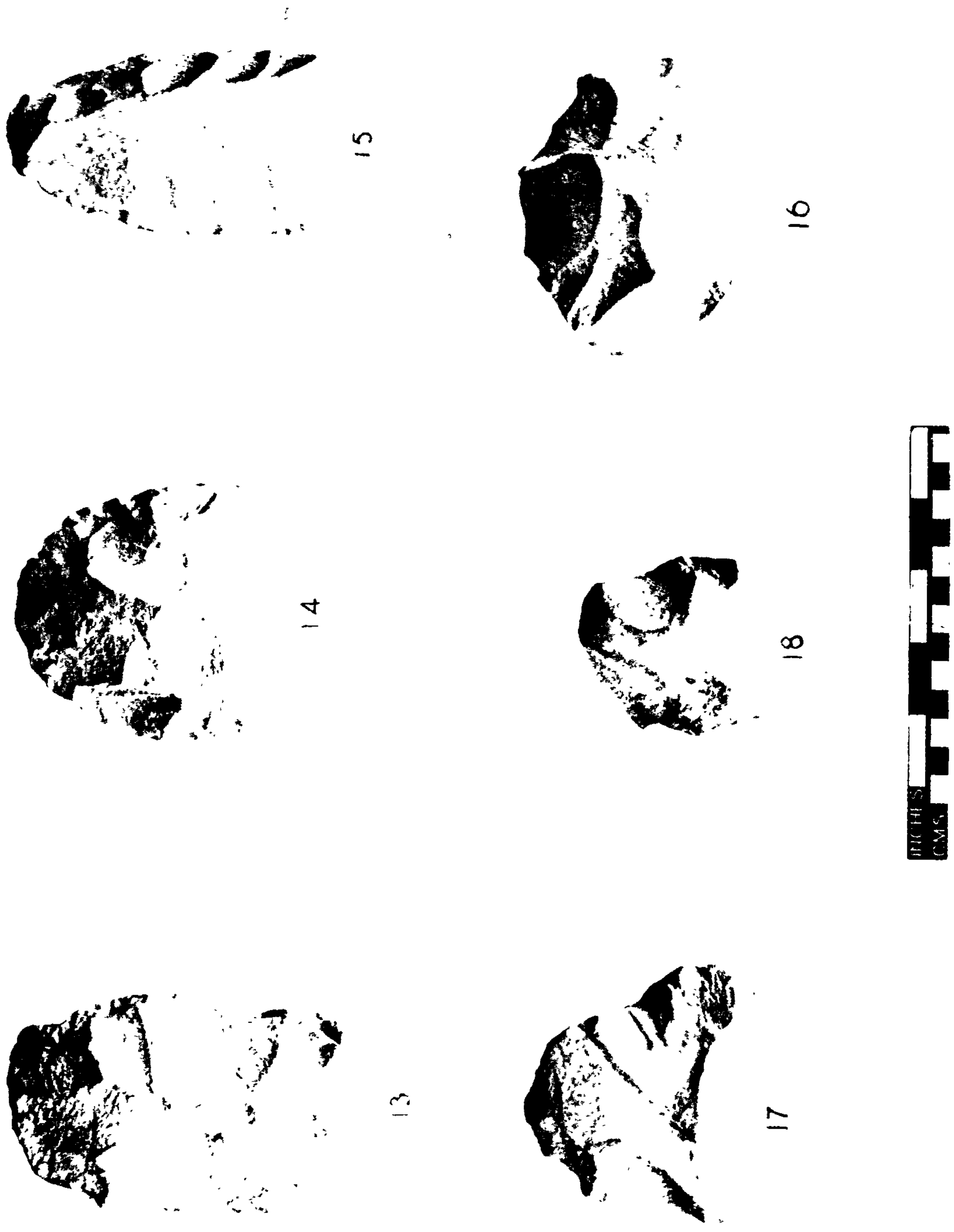
22. This is again an Acheulian handaxe with a flattish lower side with a hump on the middle of the upper side and a mid-rib from it towards the tip. The tip-portion is tongue-shaped. Part of the upper left side near the grip-end has a cortical patch.

23. This is a small ovoidal handaxe on greenish quartzite with an almost straight peripheral cutting-edge and secondary stepped flaking and a slightly curved tip. This was a tool found *in situ.*

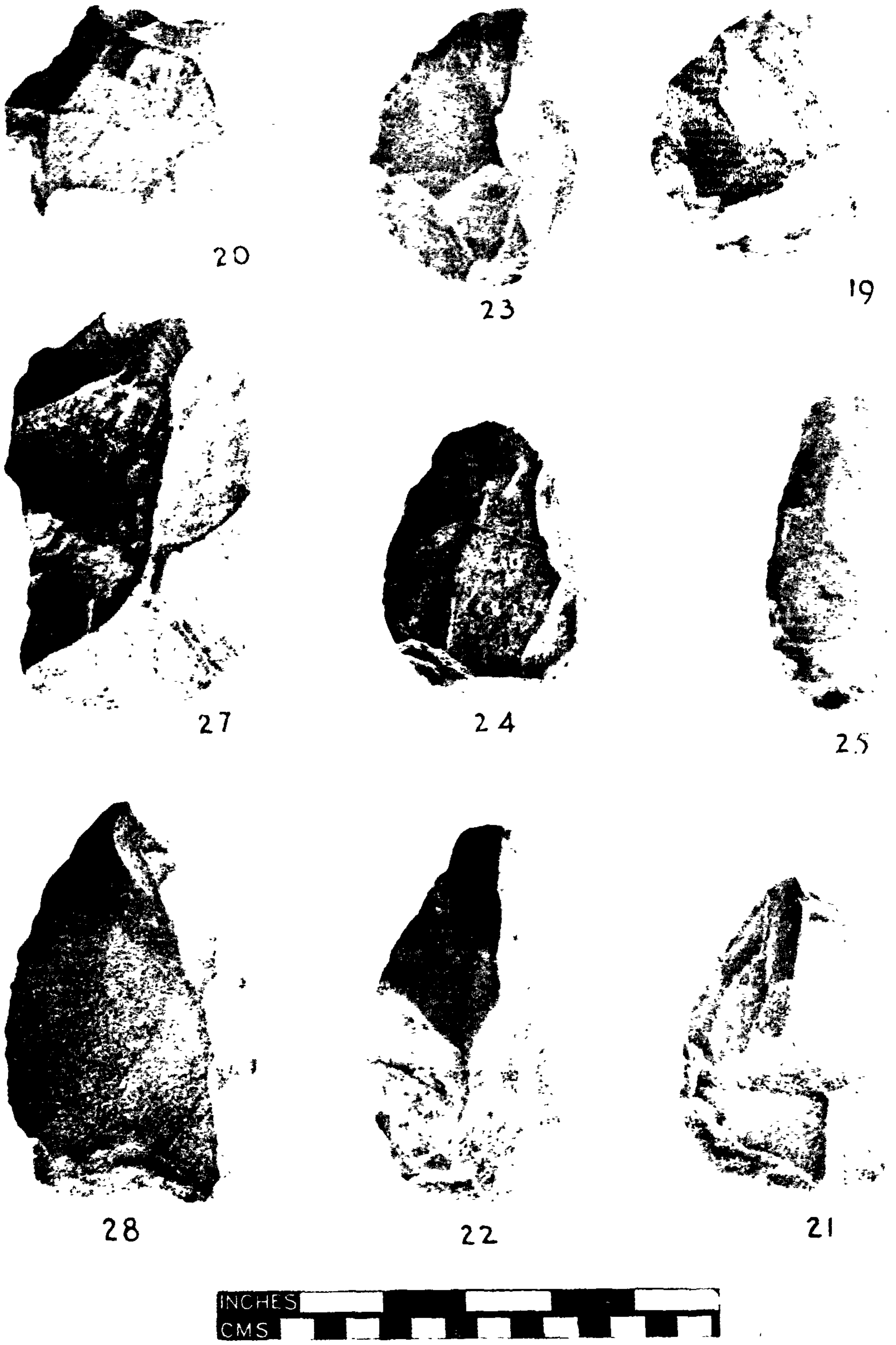
24. This is a small early middle Acheulian handaxe made of brownish quartzite. It has a sharp and more or less straight cutting-edge all around except near the butt-end, which has a small cortical patch and has a thin tongue-shaped tip-end.



Palaeoliths from Giddalur I: 7-9, handaxes; 10 and 11, ovates; 12, cleaver



Palaeoliths from Giddalur I: 13-15, cleavers; 16, core; 17 and 18, core scrapers



Palaeoliths from Giddalur II: 19 *and* 20, *pebble tools;* 21-25, *handaxes;* 27 *and* 28, *cleavers* (26, *flake-made tool, not illustrated*)

To face page 79

A. *Palaeoliths from Giddalur II:* 29-35, *prepared platform (Levallois) flakes;* 36 *and* 37, *coarse burinate flakes;* 38-40, *bladish flakes*

B. *Palaeoliths from Giddalur II:* 41-46, *unifaceted (Clactonian) flakes* (47, *core, not illustrated*)

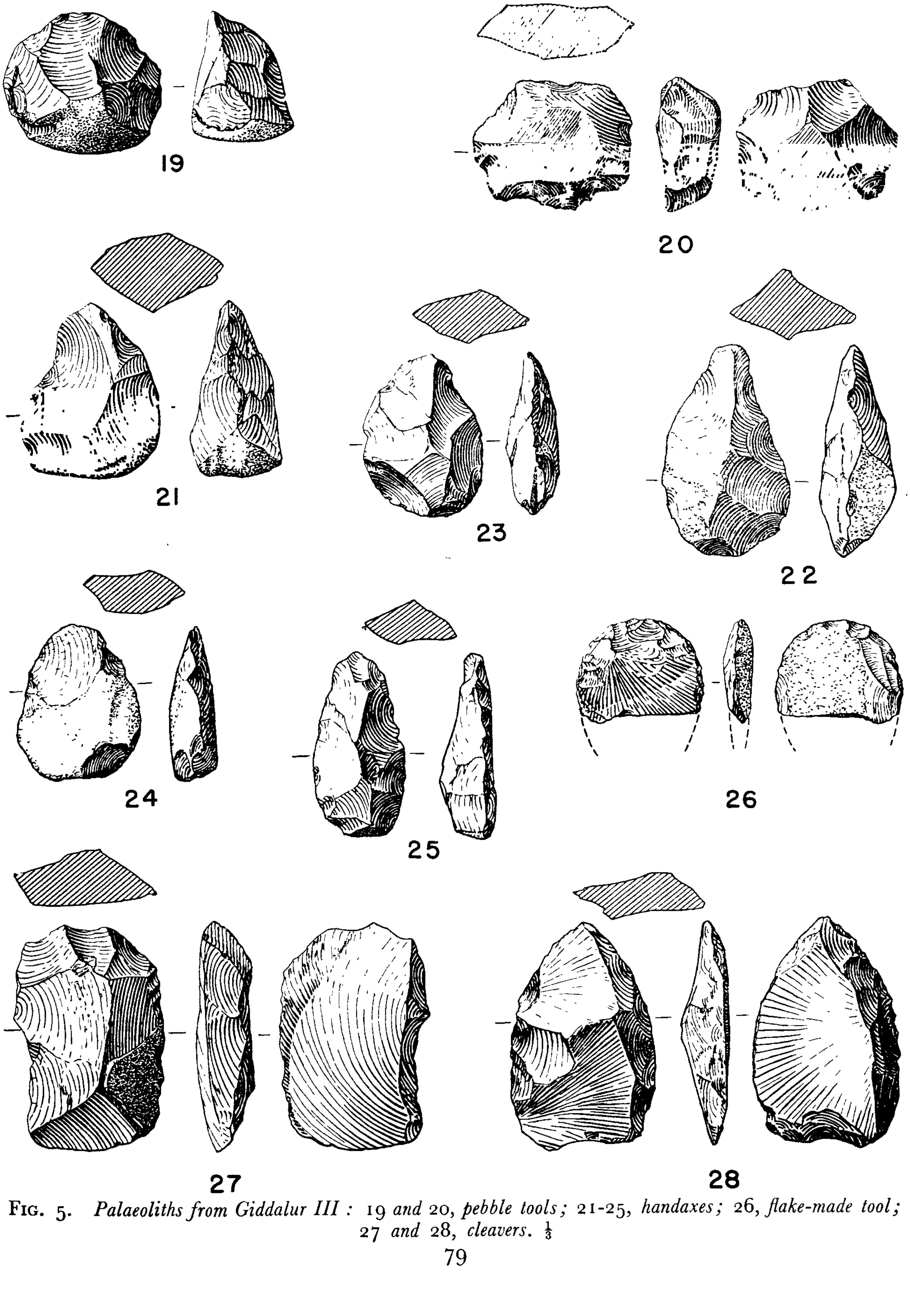


FIG. 5. *Palaeoliths from Giddalur III :* 19 *and* 20, *pebble tools;* 21-25, *handaxes;* 26, *flake-made tool;* 27 *and* 28, *cleavers.* $\frac{1}{3}$

25. This is a small pear-shaped handaxe made on a flake with a battered platform at the butt-end, the flake-surface entirely covering the ventral side. A flake removed on the dorsal cortical side near the tip has resulted in a sharp thin edge.

26. This is another flake-made tool with cortical patch forming a major part of the dorsal side. Unfortunately the tool was broken into two, and as only the upper half is available to us it is not possible to say whether it is a handaxe or an ovate. The ventral side is formed of the flake-scar ; the bulb has been removed by secondary trimming, and very deep stepped flaking is apparent around the periphery. Besides, a special feature of the tool is that looking at it sideways one is able to notice that it seems to have the 'S'-twist.

(ii). *Cleavers* (fig. 5 ; pl. XIX)

27. This is a cleaver, the edge of which has been the result of a single Vaal blow struck from the right-hand margin of the ventral side. The margin has been secondarily trimmed throughout the entire length, and this has resulted in a roughly parallelogram cross-section. The dorsal side has a patch of pebble cortex near the lower right end and has a flake removed near the lower edge to meet the ventral flake in a straight cutting-edge.

28. This is a fine specimen of a triangular-shaped cleaver, made on the double Vaal technique and thus has a regular parallelogram cross-section. Secondary stepped flaking has provided the tool with a pointed tip. The straight cutting-edge is notched, probably due to utilization.

(iii). *Prepared platform* (*Levallois*) *flakes* (fig. 6 ; pl. XX A)

29. This has a regular faceted striking-platform and a suffused bulbar scar. All along the margins secondary retouch is visible making it a useful scraper. The material is weathered brownish quartzite.

30. A small broad tongue-shaped flake with a broad prepared platform and suffused bulb, mid-rib on the dorsal side and sharp edges.

31. This is a bigger tongue-shaped flake with the platform removed by secondary working. The ventral side is of a flat flake-scar and the entire periphery on the dorsal side has steep secondary retouch which has turned it into a very efficient side-*cum*-end scraper. It is made of brownish quartzite almost turned into sandstone by weathering.

32. This is a small beautiful flake tool which has been turned into a double end-scraper by the steep retouching of the platform-end as well as the alternate dorsal bottom-edge. Particularly the latter has been nicely trimmed into a ' nosed ' end-scraper with ' nibbled ' retouch recalling its Upper Palaeolithic ' Aurignacian ' counterparts.

33. This is a nice little flake with a broad and battered platform and ' eraillure ' on the ventral side. The flake tapers towards the tip-end which is thick due to the central mid-rib (on the dorsal side) and has steep retouch at the end and is thus efficient as an end-scraper.

34. This is a unique flake of true bladish aspect with an almost deliberate backing along one margin and sharp serrated edge on the other. Both the upper and the lower ends seem to be truncated and thus the direction of the knock or the platform is not discernible; but it is likely to be on the less flattish end. This is a knife-blade and with the truncation of its bulbar scar and backing would be a clear example of the element of Upper Palaeolithic culture in Giddalur II industry in spite of its slightly bigger size.

35. This is a small specimen made on lydianite (which is the material partly used for series IV and occasionally for series II in Kurnool). It has a prepared platform and negative flake-scar on the ventral side. The entire peripheral edge of this side is steeply

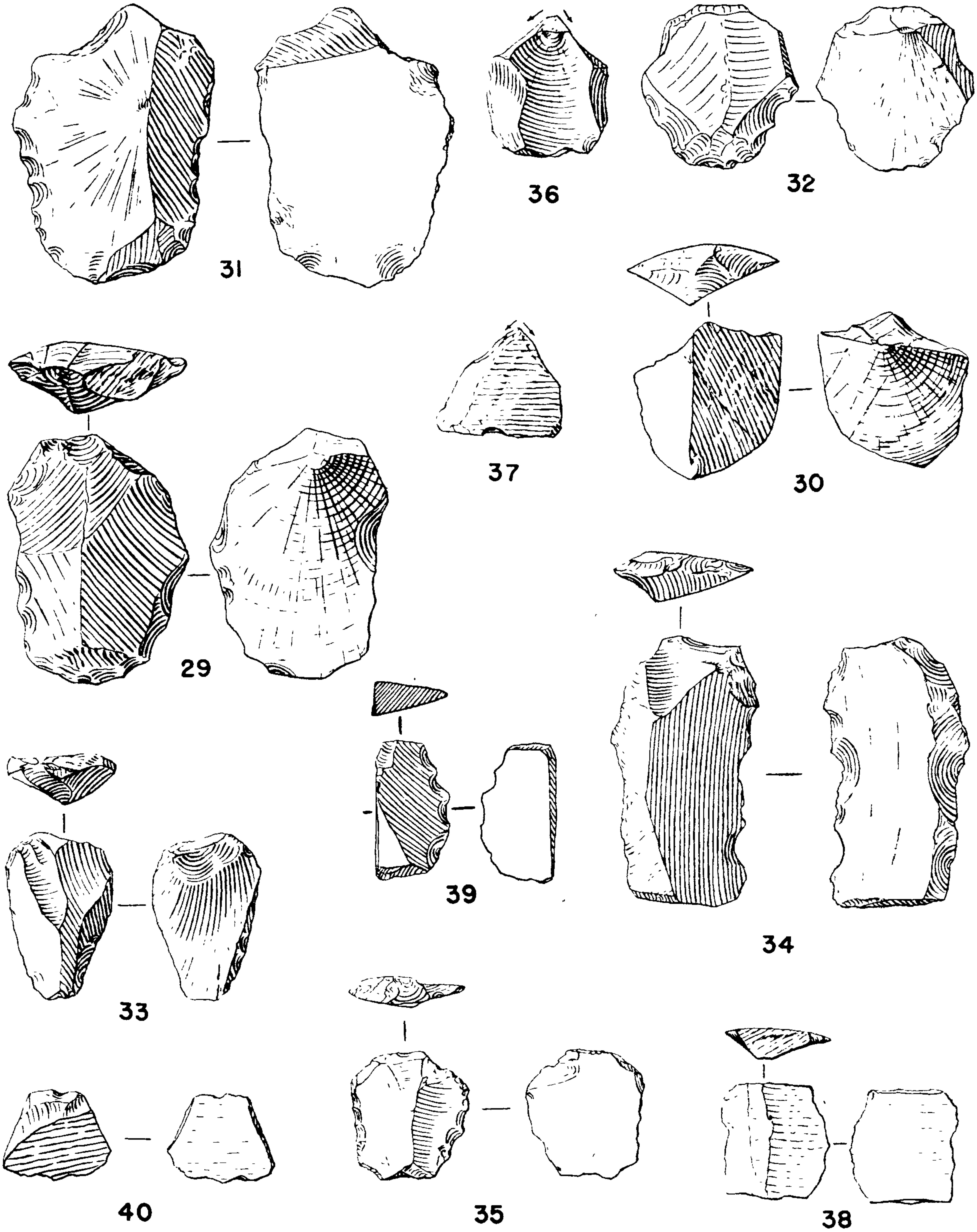


FIG. 6. *Palaeoliths from Giddalur II :* 29-35, *prepared platform (Levallois) flakes ;* 36 *and* 37, *coarse burinate flakes ;* 38-40, *bladish flakes.* $\frac{2}{3}$

retouched and serrated, and the flake would thus be an effective scraper. This would belong typologically to a stage between series III and IV.

(iv). *Coarse burinate flakes* (fig. 6 ; pl. XX A)

Nos. 36 and 37, together with a third example, not illustrated, which seems to be a case of the removal of a single spall, with the rest of the edge minutely retouched, obviously indicate the existence of burins, though there is no really good specimen of the type in our collection of the series III industry of Giddalur.

36. This is a specimen probably of a central (angle) burin type and has two opposing spalls removed across the main plane of a thin quartzitic flake giving a restricted burin-edge.

37. Another specimen perhaps of the same type as no. 36.

(v). *Bladish flakes* (fig. 6 ; pl. XX A)

38. This is a squarish flake with both ends truncated and with a mid-rib on the dorsal side and with serrated edges on both sides. It is perhaps a knife-blade. This would typologically belong to series III.

39. This is another bladish flake with thick flattish back serrated saw-edged side and steeply retouched lower end. It is on pale bluish quartzite.

40. This is a trapezoidal flake on greenish quartzite with the smaller parallel side backed and the broader one much serrated. This is an indication and forerunner of the trapezoids of the microlithic series and would typologically belong to the end of series III. It should, however, be mentioned here that our microlithic collections do not contain any example of trapezoids.

(vi). *Unifacted (Clactonian) flakes* (fig. 7 ; pl. XX B)

These range from medium to big flakes with obtuse striking-platforms and prominent bulbs made mostly on brownish quartzite to small ones on bluish or greenish quartzite. Of the fiftyfour specimens in the collection thirtyfive would belong, in respect of size and material, to series II and the rest to series III. There are many among these which have clear secondary retouch so as to be functionally useful as scrapers.

41. This is a small tongue-shaped flake with a mid-rib on the dorsal side formed by an oblique platform and opposite bulbar face, and with the bulbar scar and the entire periphery on the ventral side having secondary retouch. The material is bluish quartzite, which is largely the material used for these specimens of series III.

42. This is a medium-sized flake made on pale brownish quartzite with a mid-rib, a restricted flat platform and ' eraillure ', and with the side-edges steeply retouched to serve as a side-scraper.

43. This is a side-blow flake, the dorsal left edge of which has been secondarily trimmed to serve as a side-scraper and has a notch on bottom left which might have served as a hollow scraper-edge.

44. This is a thick tongue-shaped flake on bluish quartzite. It is broad near the platform but the lower nose has fine nibbled retouch for efficient use as an end-scraper. It recalls the Aurignacian nosed ' grattoirs '. The side-edges are also retouched so that the flake is useful also as a side-scraper.

45. Another but thinner tongue-shaped tool flaked on bluish green quartzite with an ' eraillure ' on the ventral side, sharp side-edges and steep retouch at the bottom-end, useful as an end-scraper.

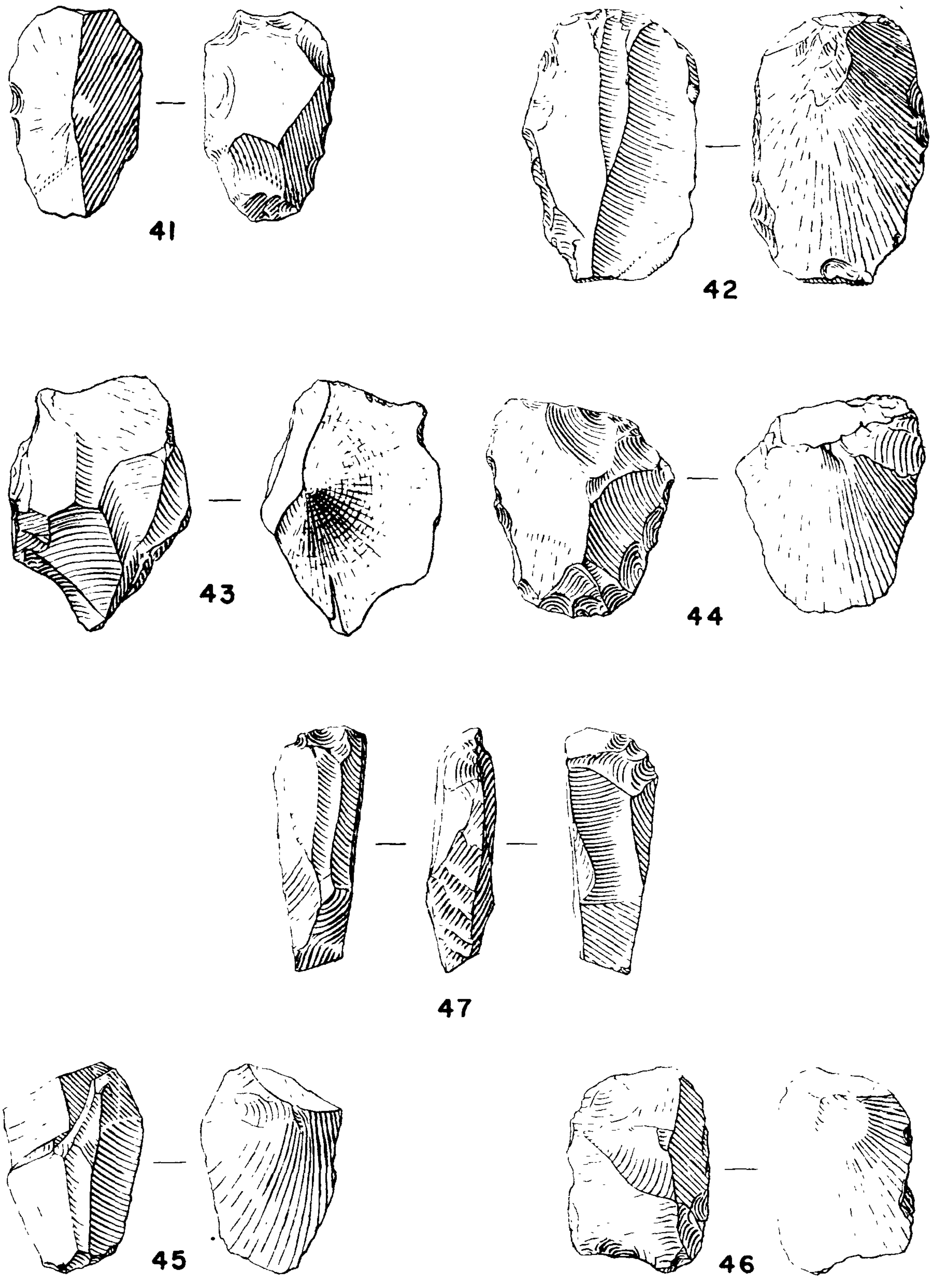


FIG. 7. *Palaeoliths from Giddalur II* : 41-46, *unifaceted* (*Clactonian*) *flakes*; 47, *core*. $\frac{2}{3}$

46. Rectangular flake in greenish quartzite with a functional notch at the lower end and thus useful as a hollow scraper.

(vii). *Core* (fig. 7)

47. This is a small elongated coroid lump of greenish quartzite with a hinged flake-scar at one end and with a series of thin flakes removed at the other end apparently by pressure-flaking. The result is evidently a scraper-edge. Similar scrapers, though on flakes, are seen to occur in the Aurignacian level at Mugharet-el-Wad, Mount Carmel, Palestine.[1] By the presence of pressure-flaking detectable on this, its place would be at the end of series III and the beginning of series IV.

C. TĀLAPALLE

(i). *Handaxes and ovates* (fig. 8 ; pls. XXI and XXII)

48. A typical and giant Abbevillean handaxe which could only have been wielded by both hands, made on brownish quartzite. It has a large and thick butt-end, very prominent mid-rib on one side and hump on another and is boldly flaked from the margin resulting in a rough rhomboidal cross-section. It has a blunt tip-end. It measures about 8½ in. in length and about 5 in. in width. The tool has comparatively fresh-looking flake-scars and appearance.

49. Early Acheulian core tool with a large pebble-butt and tapering sides neatly chipped into a straight shape by stepped flaking and with a limited cleaver-edge instead of a tip. The tool has a rhomboidal cross-section and marks the transition between bifacial handaxes and cleavers. The material is brownish quartzite.

50. Acheulian core handaxe with a weathered cortical butt and fairly straight sides trimmed by stepped flaking. It tapers into a lanceolate, though blunted, tip-end recalling the 'Micoquian' coups-de-poing of Europe. It is made on bluish quartzite and has a rolled appearance.

51. A handaxe of regular pyriform shape on a flake with the ventral side formed by the flake-surface entirely and only the dorsal trimmed to shape. It has a roughly plano-convex cross-section. Indicative of a Middle Palaeolithic influence over a Lower Palaeolithic industry, this forms a significant group in the Tālapalle industry. The material is brownish quartzite and the tool looks rolled.

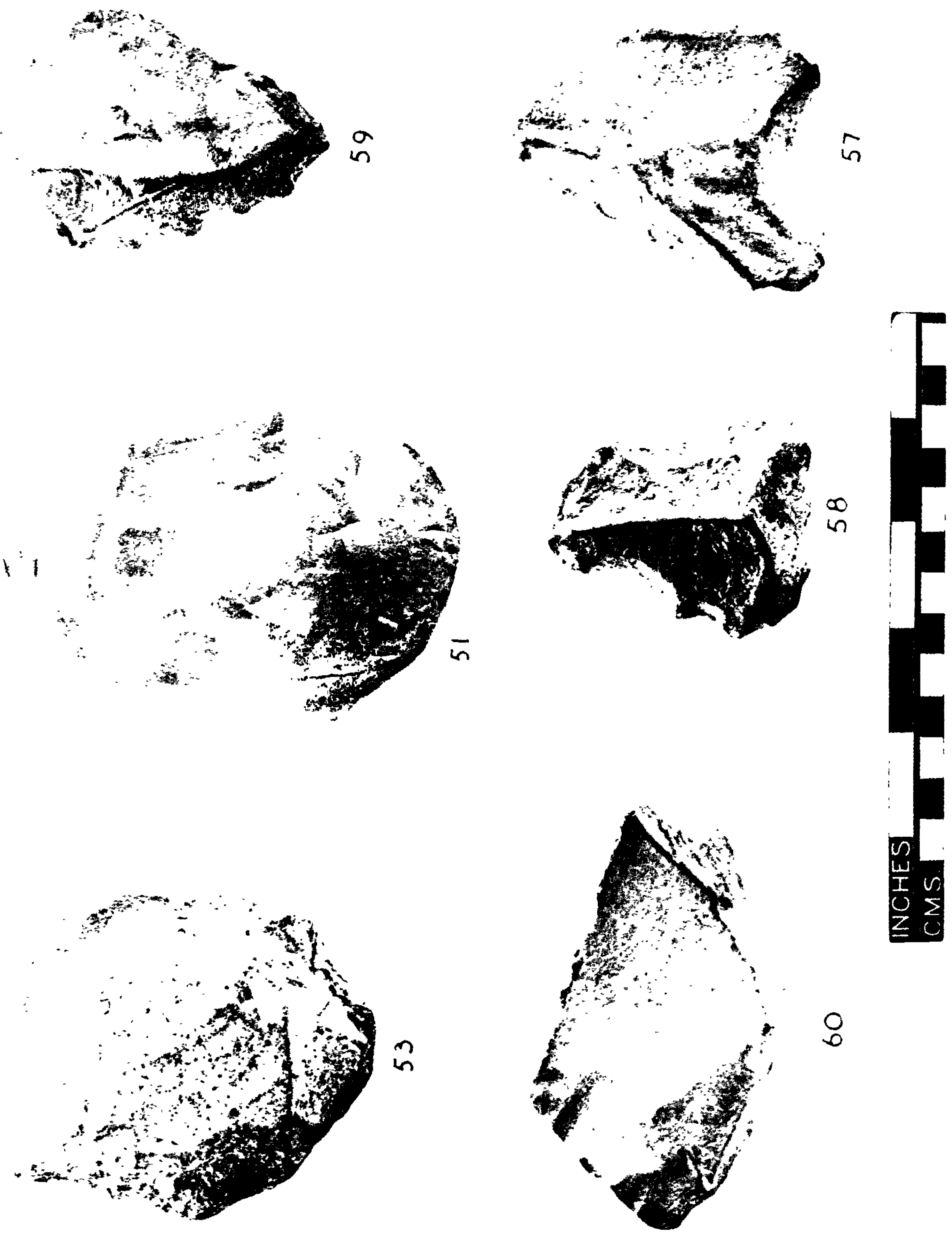
52. This is another flake-made handaxe on greenish quartzite. It is, however, bifacially chipped with the edges showing fine resolved flaking. On the ventral side the bulbar scars have been removed by secondary trimming and a few more flakes have been removed along the edges. The tip, which must have been pointed, is unfortunately broken. The trimming of the edges shows a laterally inverted 'S'-twist along one side. Slightly rolled.

53. This is a fairly regular ovate made on greenish shaley quartzite with the straight periphery exhibiting marks of stepped flaking and looking much battered. The ventral side has a flattish flake-scar, though the upper part including the bulb is trimmed away. This flake-surface is obtained particularly by a single Vaal blow, and thus the tool is thinner in the lower part.

54. This specimen, made on greyish brown quartzite, is the only one exhibiting the Victoria West technique, with an extensively chipped dorsal side and the ventral

[1] D. A. E. Garrod, 'The Upper Palaeolithic in the light of recent discovery', *Proc. Prehis. Soc.*, IV (1938), pp. 1 ff.

Palaeoliths from Tālapalle: 48-50, 52 *and* 54, *handaxes and ovates;* 55 *and* 56, *cleavers*



Palaeoliths from Tālapalle: 51 and 53, handaxe and ovate; 57-60, flakes and flake tools

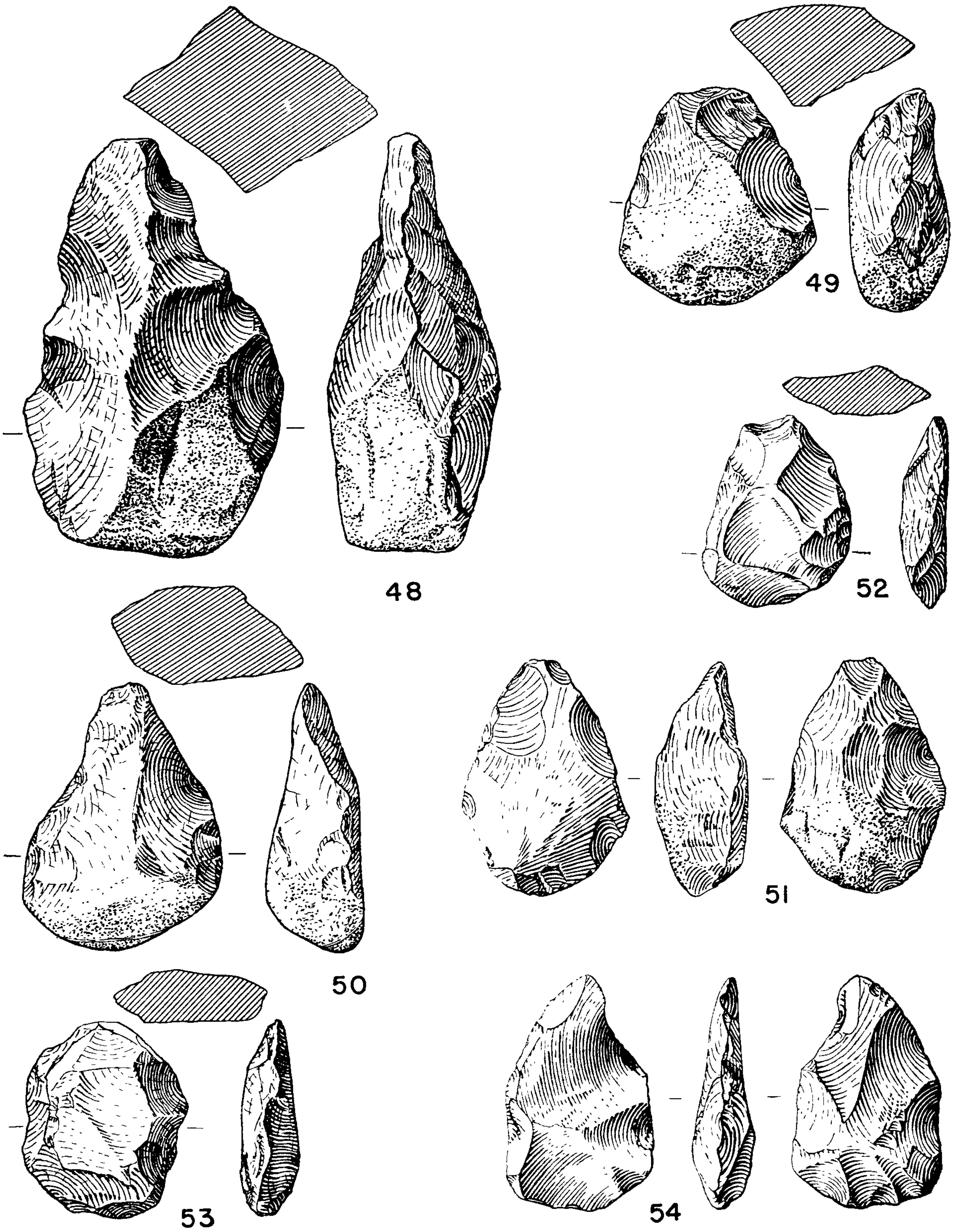


FIG. 8. *Palaeoliths from Tālapalle : 48-52 and 54, handaxes; 53, ovate.* ⅓

side having a major deep negative flake-scar. The side-edges, though wavy, are trimmed by stepped flaking. The tip is slightly curved.

(ii). *Cleavers* (fig. 9 ; pl. XXI)

55. This is a rolled specimen of an ordinary cleaver-type made by the bifacial technique on very similar lines as the handaxe but for a side-blow from one of the edges. It has a humped middle part on both sides and has thus a roughly rhomboidal cross-section. The cleaver-edge is rather oblique (' guillotine '-like) either due to differential wearing or in the original tool itself. This tool would typologically correspond to the early Acheulian bifaces. It is brownish quartzite almost metamorphosed into sandstone.

56. This is a tool which was found *in situ* in the 20 ft. section on the Enumaleru river near Tālapalle (above, p. 72) and is an excellent example of a cleaver-type exhibiting double Vaal technique and thus having a parallelogram cross-section. It has a rounded pebble-butt and is boldly flaked and not fully finished. It is made on pale brownish quartzite and has the stain of the reddish silt-deposit, at the junction of which with the underlying gravel-bed it lay. The tool is in a perfectly fresh condition with sharp side and lower edges.

(iii). *Flakes and flake tools* (fig. 9 ; pl. XXII)

57. This is a typical specimen of a hollow scraper (or spoke-shave) on a Clacton flake. It is triangular in shape, and the flake-surface, with a positive bulbar scar on the underside, is caused by a side-blow from right. The lower end has the functional notch showing slight retouch also. The upper surface is also a flake-surface caused by a side blow from left, again with a positive bulbar scar. There is a slight trimming of the sharp right margin also, so that the tool could serve as a side-scraper as well.

58. This is a small Clacton flake, which tends to be a proto-Levallois flake tool owing to its upper surface being trimmed to some shape and also to the steep secondary retouch all along the edges of the flake except in the meagre platform-side. The flake is narrower near the platform and broader at the lower edge. The powerful blow that fell on the platform is suggested by the ripple on the ventral flake-surface.

59. This tool, with its beautiful and symmetrical triangular shape and a somewhat prepared platform, would seem to be an advance upon no. 58. The left margin and a part of the right near the sharp tip show steep secondary trimming. This would tend to be placed in the Middle Palaeolithic and would be a forerunner of the true Mousterian.

60. This is a rather unique and solitary example of what is called a ' concavo-convex scraper '. It consists of a negative flake-scar on the upper side and a positive bulbar scar on the underside struck along the same platform. The two broad tapering sides opposite to the bulbs are steeply trimmed and they meet in a ' nose ' which shows nibbled retouch. The platform is not straight but angular. Perhaps a forerunner of the ' Mousterian '.

D. Kanchipalle

(i). *Handaxes* (fig. 10 ; pl. XXIII)

61. This is a heavily rolled Abbevillean tool, probably a handaxe, the heavy butt of which has much of cortical surface and the upper edges have bold bifacial flaking. The tip is blunt. Brownish quartzite.

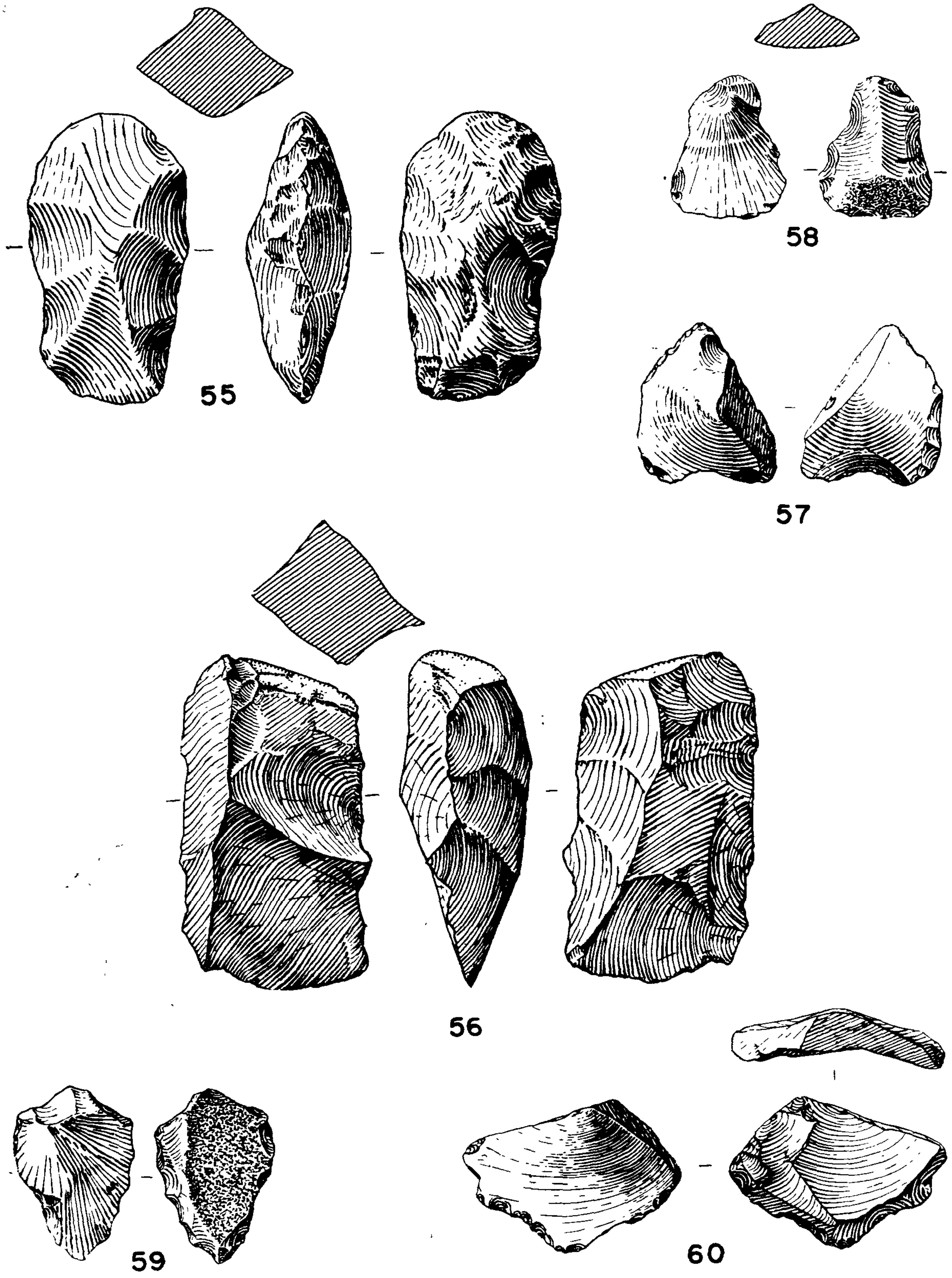


FIG. 9. *Palaeoliths from Tālapalle :* 55 *and* 56, *cleavers;* 57-60, *flakes and flake tools.* $\frac{1}{3}$

62. Beautiful and regularly chipped early middle Acheulian handaxe with an almost straight edge all around, with mid-rib on both sides but with flattened and thin tip-end and with a flattish cortical butt-end. Stepped flaking is apparent along part of the edge.

(ii). *Flake* (fig. 10 ; pl. XXIII)

63. Tongue-shaped Clactonian flake with a broad and right-angular striking-platform. The bulb has partially been removed by a side-blow given near it on the left, apparent from the negative scar of this blow. The edge shows battering, probably due to collision in transport. The dorsal side is entirely made up of cortical patch.

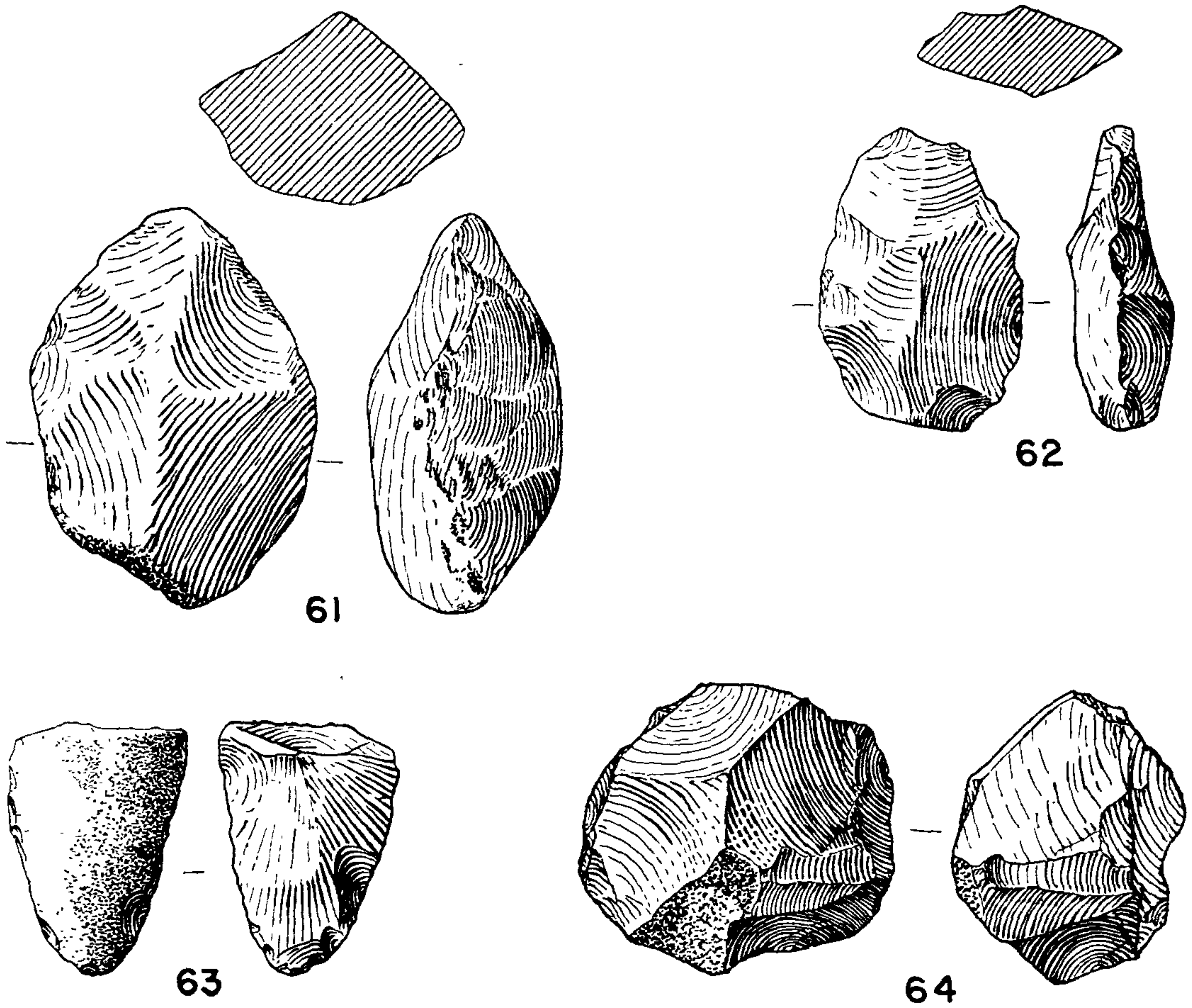
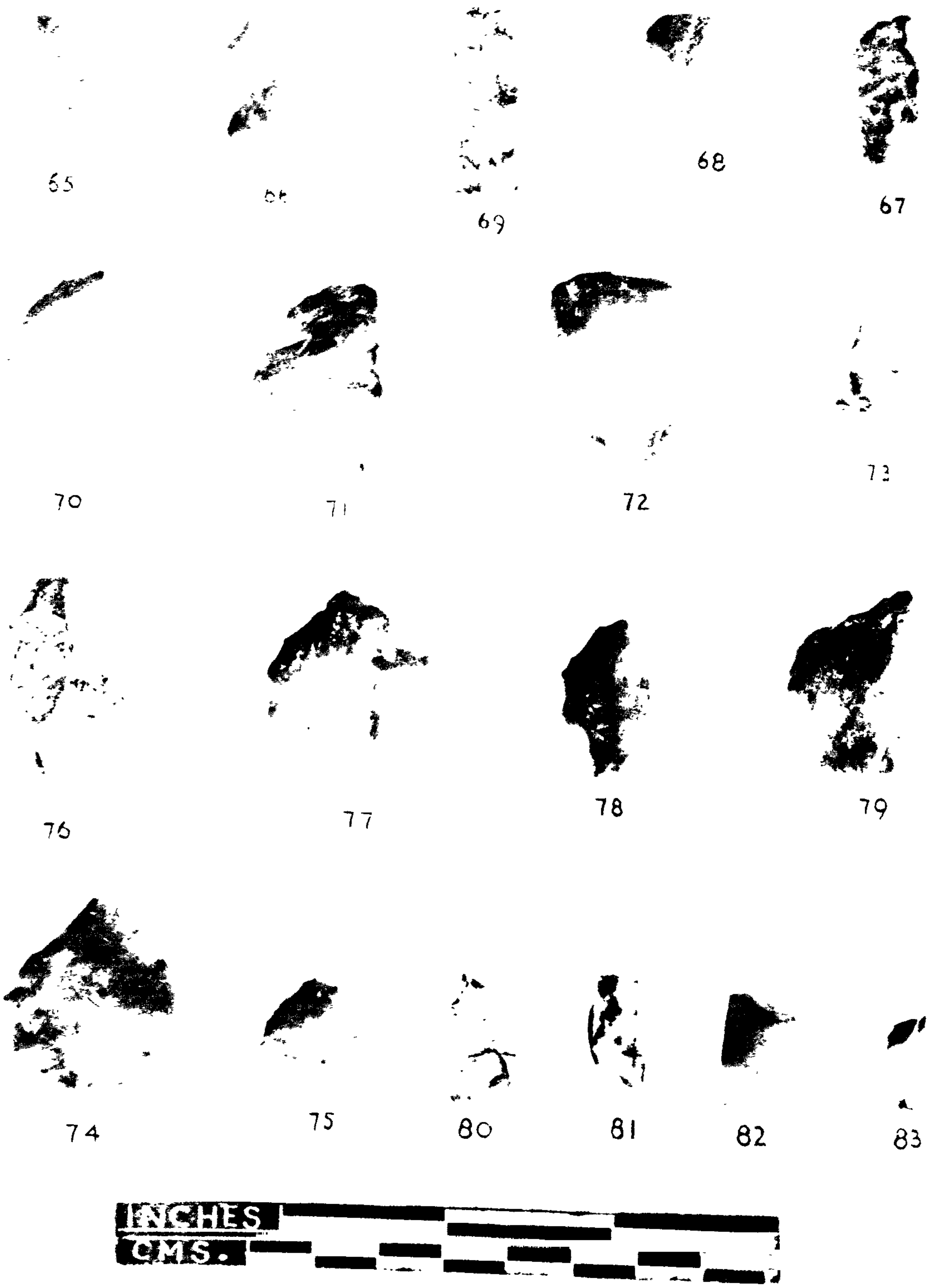


FIG. 10. *Palaeoliths from Kanchipalle:* 61 *and* 62, *handaxes ;* 63, *flake ;* 64, *core.* $\frac{1}{3}$

(iii). *Core* .(fig. 10 ; pl. XXIII)

64. Clactonian core in a fresher condition than with a flattish lower surface formed of marginal negative flake-scars and with a high hump on the upper side, which also retains a cortical patch.

Palaeoliths from Kanchipalle : 61 *and* 62, *handaxes* : 63, *flake* ; 64, *core*



Microliths from Giddalur II: 65 *and* 66, *parallel-sided blades;* 67-69, *backed blades;* 70 *and* 71, *lunates;* 72 *and* 73, *scrapers;* 74 *and* 75, *almond-shaped points;* 76-79, *tanged points;* 80-82, *burinate tools;* 83, *obliquely blunted point*

6. THE MICROLITHIC INDUSTRY OF GIDDALUR II

A. The material and types

Quartz veins occur in all horizons in the Nallamalai range but are most conspicuously displayed in the Sāgileru plain, where they come to the surface for miles from north to south in white ridges, reefs and their debris. The veins are milky white in colour.

The microlithic industry of Giddalur II is characterized by (i) parallel-sided blades (eight), (ii) backed blades (nine), (iii) lunates (three), (iv) side- and end-scrapers (three), (v) borers (two), (vi) almond-shaped points (nine), (vii) tanged points with single and double shoulder (four), (viii) burinate tools (seven), (ix) obliquely blunted point (one) and (x) cores (ten). A majority of the tools has been made on vein-quartz of the milky variety, while the remainder is variously made on greenish quartzite, banded or mottled (red) jasper, lydianite, agate and chert. Hammer-technique and pressure-flaking technique appear to have been utilized alike. The tanged and the almond-shaped points seem to bear typological comparison with African Aterian, Late Still Bay and Wilton types. The burins are essentially of the spalled order, comprising angle as well as transverse types, while there is a single incomplete specimen of the fluted order also. The tools represent series IV of Burkitt and Cammiade.

The cores are short blade-cores, mainly of the fluted as well as the chisel-ended or conical types, besides a few multi-directional lumps also. They have prepared as well as shallow-dished platforms. As the material, quartz, is very intractable, the relative difference in bulk of waste flakes to true tools is enormous. The collection, consisting of about fiftyfive genuine artefacts, would seem to have all the general traits of an Epi-palaeolithic-microlithic industry.

B. Description of the tool-types

The following tools represent the characteristic types in the collection. Where not specifically mentioned, the material is milky or dyke-quartz.

(i). *Parallel-sided blades* (fig. 11 ; pl. XXIV)

65. A specimen with both ends truncated, with a low mid-rib on the upper side which has also been partly trimmed flatly. The side-edges show serrations, probably due to use.

66. Part of the platform and bulb has been trimmed away. It has a flattishly worked upper side, and the side-edges show delicate secondary retouch.

(ii). *Backed blades* (fig. 11 ; pl. XXIV)

The following four tools represent the characteristics of this group.

67. Example of a backed blade with the upper platform and suffused bulb present. The lower oblique end is trimmed and recalls the pen-knife blades of the Mesolithic. The left margin is backed by steep retouch and the right edge shows serrations due to use.

68. Another shorter blade with both upper and lower ends truncated and with a mid-rib to the left of the centre. Backing is not complete and is seen only near upper end, but the right edge shows secondary retouch.

69. Blade on mottled jaspery quartzite, the platform and suffused bulb present, with a straight untrimmed back on the right margin, flatly trimmed right upper surface (with ripples) and left working-edge which exhibits delicate retouch and has a small notch also near the lower end.

(iii). *Lunates* (fig. 11 ; pl. XXIV)

70. This is one of the two normal blunted arc type, the working-edge of which shows delicate retouch and is much serrated, perhaps due to use.

71. This is another lunate of almost semi-circular shape, with its thick chord blunted and with the arc sharply worked into an edge.

(iv). *Scrapers* (fig. 11 ; pl. XXIV)

72. This is a nosed end-scraper on a core, recalling its counterparts of the Upper Palaeolithic. The scraper-edge is effected by a few tiny ribbon-spalls removed vertically in the nosed edge.

73. This is a diminutive flake scraper on lydianite and its working-edge, effected on the bulbar platform itself, is characterized by fine and steep retouch.

(v). *Borers*

These two have flakes removed in such a way as to leave a sharp point useful for boring.

(vi). *Almond-shaped points* (fig. 11 ; pl. XXIV)

74. This is about the largest of the specimens of this type, being 1¼ in. along the longer side. It exhibits fine controlled pressure-flaking over both the sides and has a pointed tip.

75. This is another point just more than ½ in. long, with delicate secondary working and a slightly rounded tip.

(vii). *Tanged points* (fig. 11 ; pl. XXIV)

76. This is on greenish quartzite and has a fine tang, trimmed shoulders and a leaf-shaped and mid-ribbed upper part.

77. This is another point on quartz and has a broad upper part, fairly pointed tip, double shoulder and short tang.

78. This is a very delicately retouched specimen, much smaller than the other two, having a very pronounced shoulder and converging sharp tip.

79. This is a solitary specimen of a tanged arrow-head with a single shoulder and sharp tip. In the microlithic industries of north Africa and Europe, exquisitely worked single shouldered tanged points are very common.

(viii). *Burinate tools* (fig. 11 ; pl. XXIV)

80. This is a central (angle) burin type of the ' spalled ' order executed on a thick lydianite flake with the characteristic stepped scars of a burin-facet.

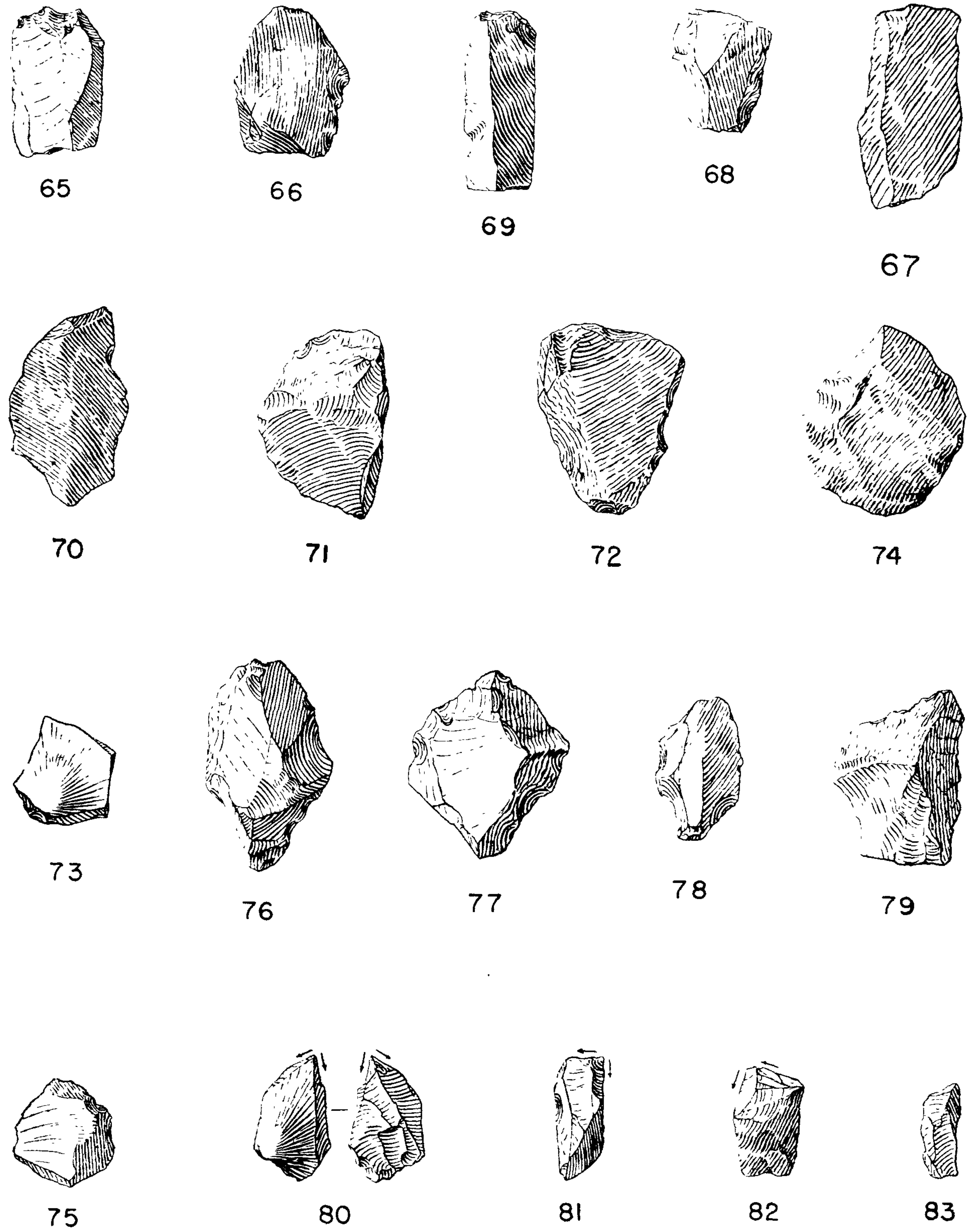


FIG. 11. *Microliths from Giddalur II :* 65 *and* 66, *parallel-sided blades;* 67-69, *backed blades;* 70 *and* 71, *lunates ;* 72 *and* 73, *scrapers ;* 74 *and* 75, *almond-shaped points ;* 76-79, *tanged points;* 80-82, *burinate tools;* 83, *obliquely blunted point.* ½

81. This is a transverse burin, again of the 'spalled' order on a core of lydianite, the burin-facet being obtained by a fine deep vertical spall meeting a transverse spall on the platform.

82. This is an incomplete specimen of the 'fluted' order roughly analogous to the 'parrot-beak' or 'polyhedric' type. This is formed by a deep concave vertical spall intersected by an array of 'fluted' transverse ribbon-scars. The specimen is made on pinkish fine-grained quartz.

(ix). *Obliquely blunted point* (fig. 11 ; pl. XXIV)

83. A diminutive piece on agate with one side backed and the other edge untrimmed and with an oblique crosswise edge ending in a point which has slight serrations along it resembling the obliquely blunted point.

7. ACKNOWLEDGEMENTS

The author wishes to record his deep obligations to Shri Raghbir Singh, Senior Draughtsman and Shri B. S. Bist of the Department of Archaeology, for the line-drawings, to Shri R. Chatterjee, Photographer, Excavations Branch, and Shri M. Naicker, Southern Circle, Madras, for the photographs and to Shri K. Ramaswami, Draughtsman-Surveyor, Prehistory Section, for the preparation of the physiographic map of the Giddalur region. He cannot but mention the very helpful suggestions he received from Shri V. D. Krishnaswami, Superintendent of Archaeology, South-eastern Circle, Visakhapatnam, during the initial stages of study of this collection.

TECHNICAL NOTES

PRESERVATION OF SOME ANCIENT PAINTINGS AND MANUSCRIPTS

By T. R. Gairola

Text-books on the preservation of museum-exhibits are likely to give stock-formulae for the treatment of classes of objects, which, if applied without proper understanding, may not yield the needed result and are even likely, in some cases, to injure the objects. Those in charge of museum-laboratories know that each object has usually its own problems and therefore requires individual attention and treatment. In this article Shri T. R. Gairola, Assistant Archaeological Chemist in the Museums Branch of the Department, describes the method adopted by him in the treatment of five objects, each belonging to a different class.

ELSEWHERE I have described in detail the method adopted for the preservation of Central Asian paintings.[1] Each object requires individual and specific treatment consistent with its nature, structure, composition and type and the extent of deterioration it has undergone ; general methods advocated for a class of objects do not, therefore, take us very close to the practical measures required to tackle individual problems which confront persons engaged in the preservation of antiquities and other objects of art. Here I intend to describe the methods employed for the preservation of five different types of objects which have been chemically treated during the last few years. A block-print, two paper manuscripts, an oil-painting on canvas and a wall-painting have been selected for this purpose, and their conditions before and after treatment have been recorded through photographs. It will be seen that though some of these objects fall broadly in one group, the practical details of carrying out the preservation of each have to be modified so as to get the desired results.

1. A BLOCK-PRINT

The block-print was on paper printed with carbon ink in an organic medium.[2] It was one of the thousands of block-prints recovered by Sir Aurel Stein from Central Asia, having been found in Ch'ien-fo-tung or Cave Temples of The Thousand Buddhas, situated on the southern route followed by him during his explorations in Chinese Turkestan in the years 1900-01, 1906-08 and 1913-16. It belonged to a period between the seventh and tenth centuries A.D. and illustrated a Buddhist subject with Mañjuśrī riding a lion and two attendants at the top and a prayer in Chinese characters at the bottom.

The paper was of medium quality having long fibres which accounted for its preservation in whatever condition it was at the time of the treatment. As will be seen from pl. XXV A, the surface was full of foreign accretions with various kinds of stains (grease, fly-marks etc.). There were many folds and creases. The surface had several cracks and

[1] *Journal of Indian Museums*, V (1949), pp. 36-39.
[2] The ink remained unaffected with water but spread with chloroform.

the edges were brittle, though the paper retained its suppleness. On account of the surface-accumulations the drawing and the script were not quite legible.

Its proper preservation called for the following treatment. The print was laid on Nepalese tissue-paper, which, in turn, was laid on a glass plate larger than the print. The loose surface-accumulations were removed with a dry sable brush and all big creases and folds made supple by applying a mixture of alcohol and water along the lines of crease and fold and pressing them with spatulas. Grease-stains were removed as far as possible by the use of cotton-swabs dipped in organic solvents (toluene, xylene, ethyl acetate, ethylene-di-chloride etc.) and the fly-marks with hydrogen-per-oxide in alcohol. After the volatile solvents had escaped completely, the block-print was subjected to water-treatment, so that the whole of it would be maintained under a continuous stream of water. An arrangement, the sketch of which is given in fig. 1, was made for this purpose.

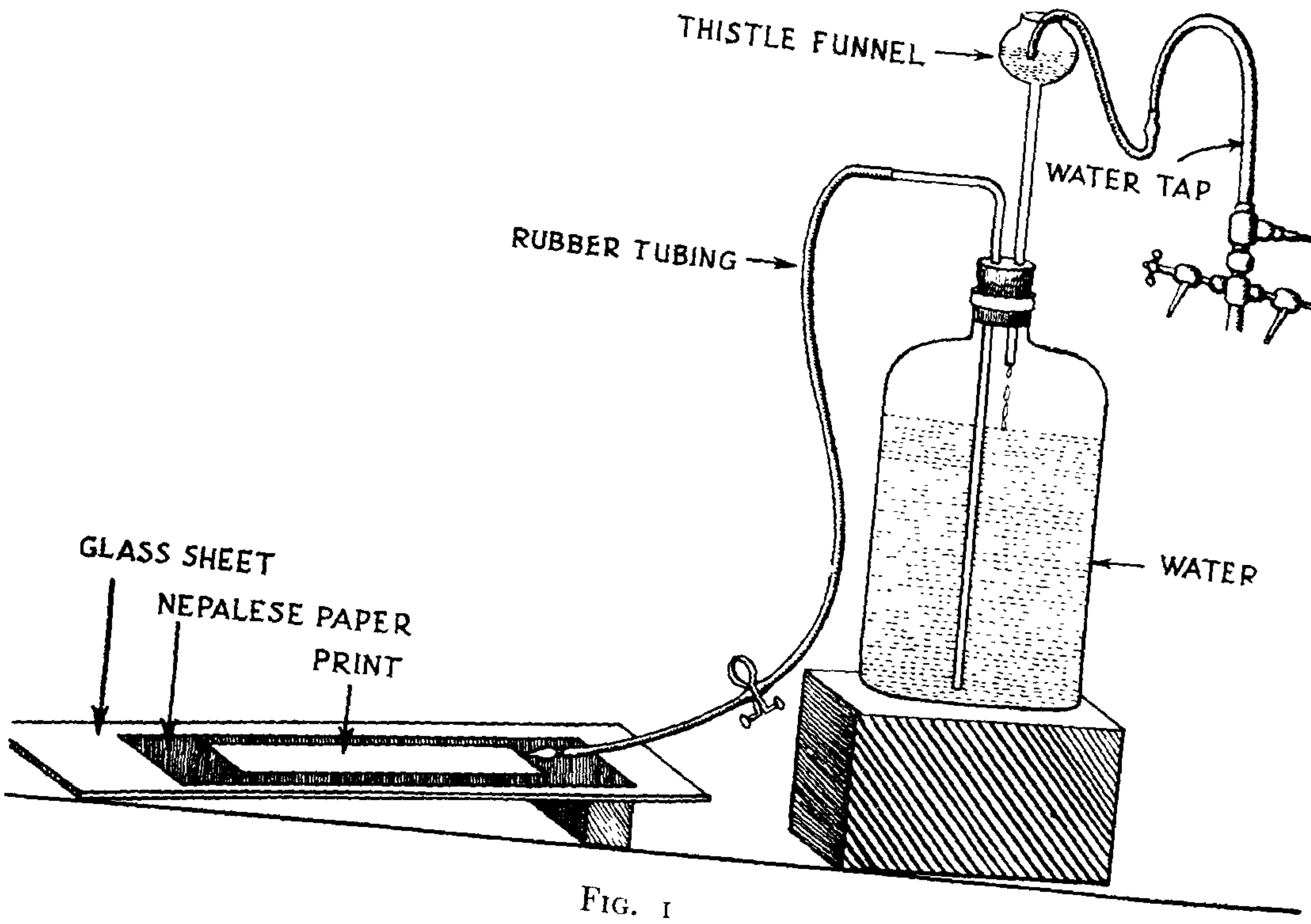


FIG. 1

Stain-removing aqueous reagents such as pyridine and bleaching powder were then applied to the spots which did not easily yield to washing treatment with plain water. These chemicals were then removed completely by washing. This treatment eliminated almost all the stains and fully flattened out the block-print all over. Areas which, during the course of treatment, were found getting weak and from which the ink was fading were immediately dried by making use of rectified spirit and introducing an adhesive consisting of 1 per cent methyl-metha-crylate in a mixture of 80 per cent toluene and 20 per cent ethyl alcohol. The treatment for cleaning was necessary for both the obverse and reverse sides in order to flatten the print thoroughly and remove the stains on both the sides. With the reverse side facing upward, two coatings of Nepalese tissue-paper were pasted

on the print with *maidā* (starch) paste.[1] Thus strengthened, the print was removed from the glass and turned upside down so as to expose the printed surface. The edges of the pasted paper were then fixed to the table to allow the block-print to dry slowly. After a day or so, when it had dried completely, it was cut into a rectangular piece leaving a convenient margin all round. It was then given a coating of ·5 per cent methyl-metha-crylate solution as above and allowed to dry. Thereafter it was left pressed upside down between glass-sheets for two days in order to arrest the curling tendency of the whole unit. Pl. XXV B shows its condition in the preserved state.

2. A MANUSCRIPT OF SANT TULSĪ DĀS

This was a manuscript supposed to have been written by Sant Tulsī Dās in Saṁvat 1669 (A.D. 1612) in black water-soluble ink. The manuscript was found backed with two layers of paper pasted together with a large quantity of *maidā* paste and also gum at some places. The paste as well as the gum showed active signs of brittleness. The manuscript and the back paper had developed individually and collectively a very large number of folds caused by undue pressure and faulty rolled condition in which it was found kept. The paper was very weak along the folds. There were several water-marks and stains on the surface. Quite a large number of tears on the body and fragility of the edges was found in the manuscript, which had become stiff due to excessive paste and its drying (pl. XXVI A).

Since the ink used was water-soluble, it was found necessary to introduce a non-aqueous fixative to preserve it before water or its alcoholic mixtures could be used to remove the paper-coatings on the back and flatten out the manuscript by dressing up the creases along the lines of fold. The first step was, therefore, to fix the letters with 1 per cent methyl-metha-crylate solution. The fixative was allowed to dry, and then trials were made at different places with damp swabs of cotton to see if the ink had been fixed properly or not. At places where ink was found spreading another coating of the fixative was applied. The manuscript was then laid on Japanese tissue-paper over an inclined glass-sheet with the back side exposed.

The back was then flushed uniformly and thoroughly with water, and when the paste had become soft the first layer of the back paper was removed from one corner carefully, so that the manuscript remained undisturbed in its position over the glass-sheet. The more sticky parts were softened by a liberal use of water through the arrangement shown in fig. 1. When this layer of paper had been completely removed, the lump of excess paste left behind on the back of the manuscript was scraped off carefully with a horn spatula, and the other layer of paper was carefully detached from the back. During the course of the removal of this layer it was found necessary to watch the front side of the manuscript through the inclined glass-sheet to ascertain that the loose fragments did not get displaced from their position. When this layer came out the back of the manuscript was brushed carefully with a fine sable-hair brush and copious flow of water to remove all the sticking old gum and paste. Excess water was then drained off and Nepalese tissue-paper fixed on the back by simply wetting it. The manuscript was then turned upside down and allowed to dry completely. Portions of the written surface where ink was found spreading were fixed up again with another coating of the fixative.

Most of the stains which were due to water-soluble matter were now found removed, but organic solvents like xylene, alcohol, petrol etc. had to be used to remove oily and fatty

[1] *Journal of Indian Museums*, VIII (1952), p. 41.

stains. When the solvents had dried the obstinate stains were treated with hydrogen-per-oxide in water and pyridine for their elimination. It was not found necessary in this case to use more drastic stain-removers such as bleaching powder. A sheet of Nepalese paper was then laid on the manuscript, which was placed upside down on the glass-plate. The tissue-paper which had previously been applied on the back was then removed and the manuscript washed thoroughly on the back with a fine jet of water till it was completely free of pyridine which had previously been used for the removal of obstinate stains. Starch paste was then applied on the back of the manuscript uniformly and two layers of Nepalese paper one after another pasted over it. The manuscript was then removed from the glass-sheet and put upside down on the wooden table, and the tissue-paper in front of the manuscript was carefully removed. The edges of the pasted back tissue-paper were pasted all over on the table and the manuscript allowed to dry for a day or so. It was cut as before, and now it is in the condition illustrated on pl. XXVI B.

3. A VARNISHED MANUSCRIPT ON PAPER

This specimen of varnished writing on thick paper in *Naskh* script was presented to the Central Asian Antiquities Museum, New Delhi, by Shri Hamid Ali in 1946. The writing was in black ink and the spacing patterns on the three horizontal stripes were executed in blue, red and gold.

It was found that the manuscript had become pale as a result of the thick varnish which had, at some stage, been applied to it either in order to protect it from the deleterious influence of the atmosphere or to restore the luminosity and transparency originally intended by the calligraphist or the artist.[1] It was thus a case of the darkening of the manuscript due to varnish.[2] On examination it was noticed that the varnish was spirit-soluble. Oxidation had started, rendering it pale-yellow and showing developments of fissures and cracks all over the surface. The whole surface presented a dark appearance, and the blue, red and old pigments of the patterns appeared nothing more than dirty patches. The manuscript as a whole was quite stiff, and if the varnish had not been removed it would have turned brown, and further drying and oxidation would have led the manuscript to break into pieces.

A suitable mixture of rectified spirit and turpentine oil was used successfully to soften the varnish which was then removed by a swab of cotton dipped in toluene. The alternate treatment with rectified spirit-turpentine mixture and toluene was continued till only a trace of the varnish was left.[3] In the end a coating of 5 per cent vinyl-acetate in a mixture of rectified spirit and toluene (1 : 1) was given to the surface.[4] Pl. XXVII shows the condition of the manuscript during the course of cleaning, the right one-third representing the cleaned and preserved part and the rest on the left the untreated portion.

4. A MODERN OIL-PAINTING

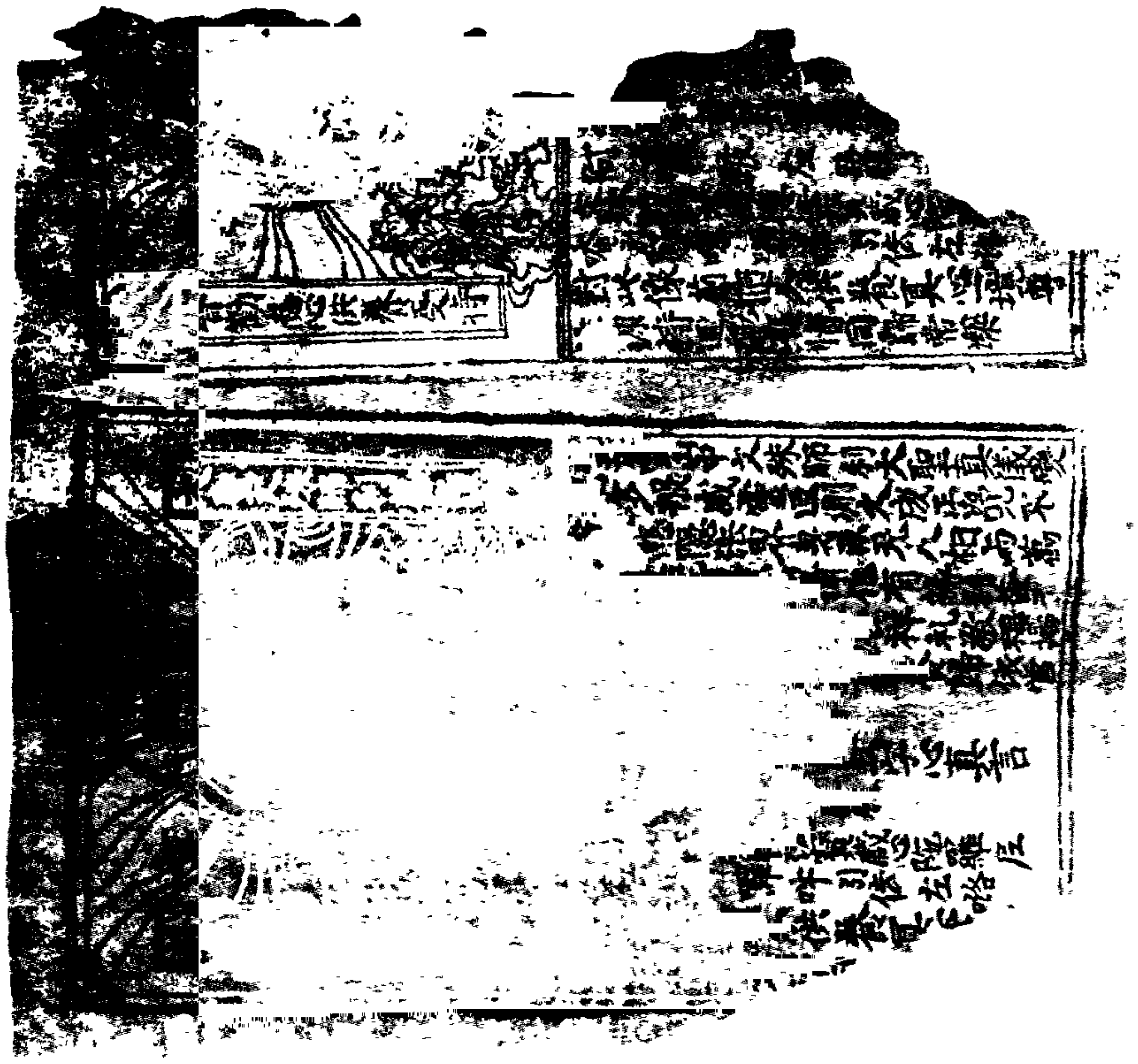
The title of this oil-painting was ' Boy with Apples ', painted by Amrita Sher Gil, one of the modern Indian painters of repute, in 1934, one year after her election as an

[1] *Manual on the Conservation and Restoration of Paintings* (International Institute of Intellectual Co-operation, Paris, 1940), p. 111.

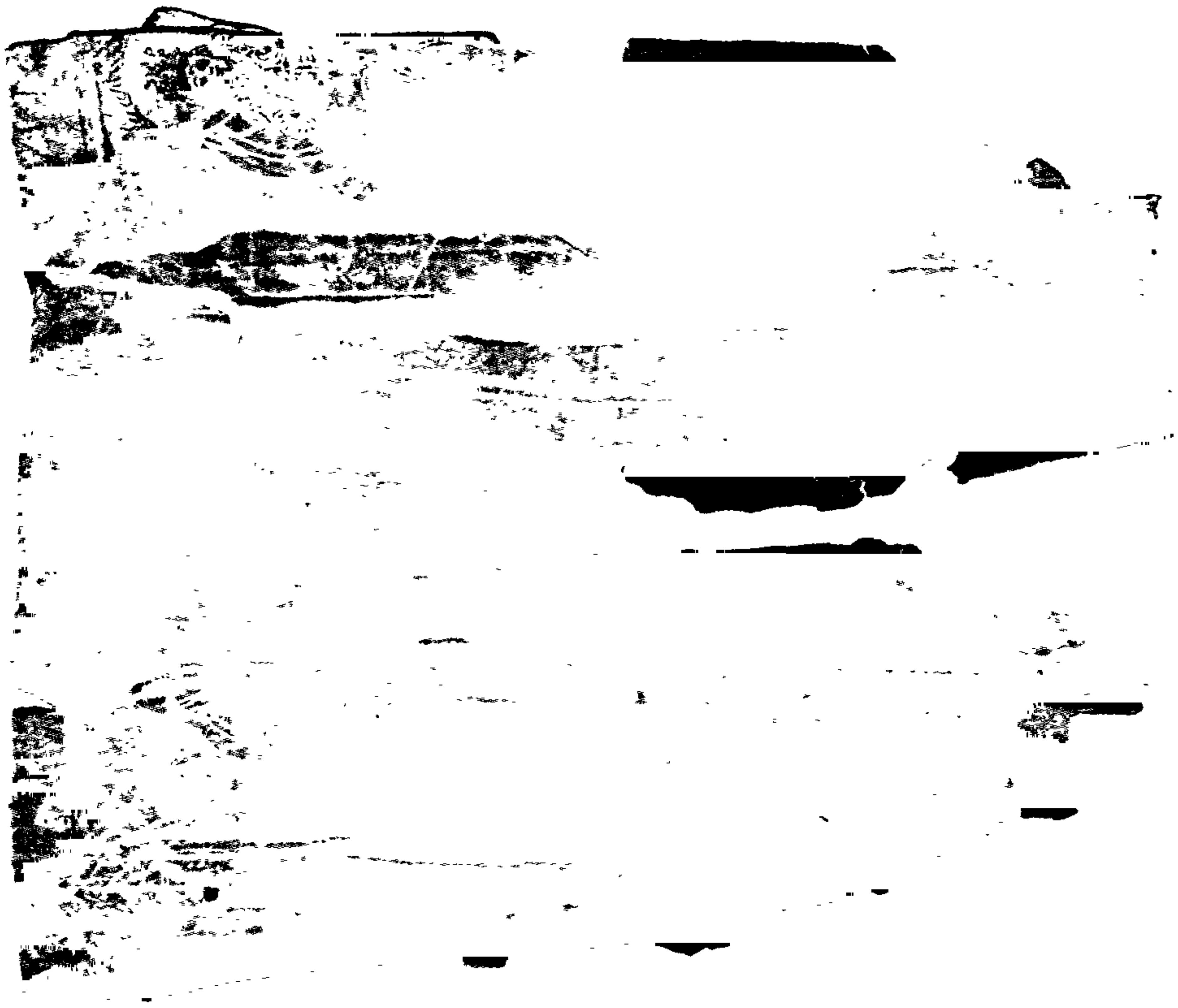
[2] *The Care of Paintings*, UNESCO publication 778, p. 104.

[3] *Manual on the Conservation and Restoration of Paintings*, p. 179.

[4] *Technical Studies in the Field of the Fine Arts*, VII, no. 1 (Harvard, 1938), p. 41.



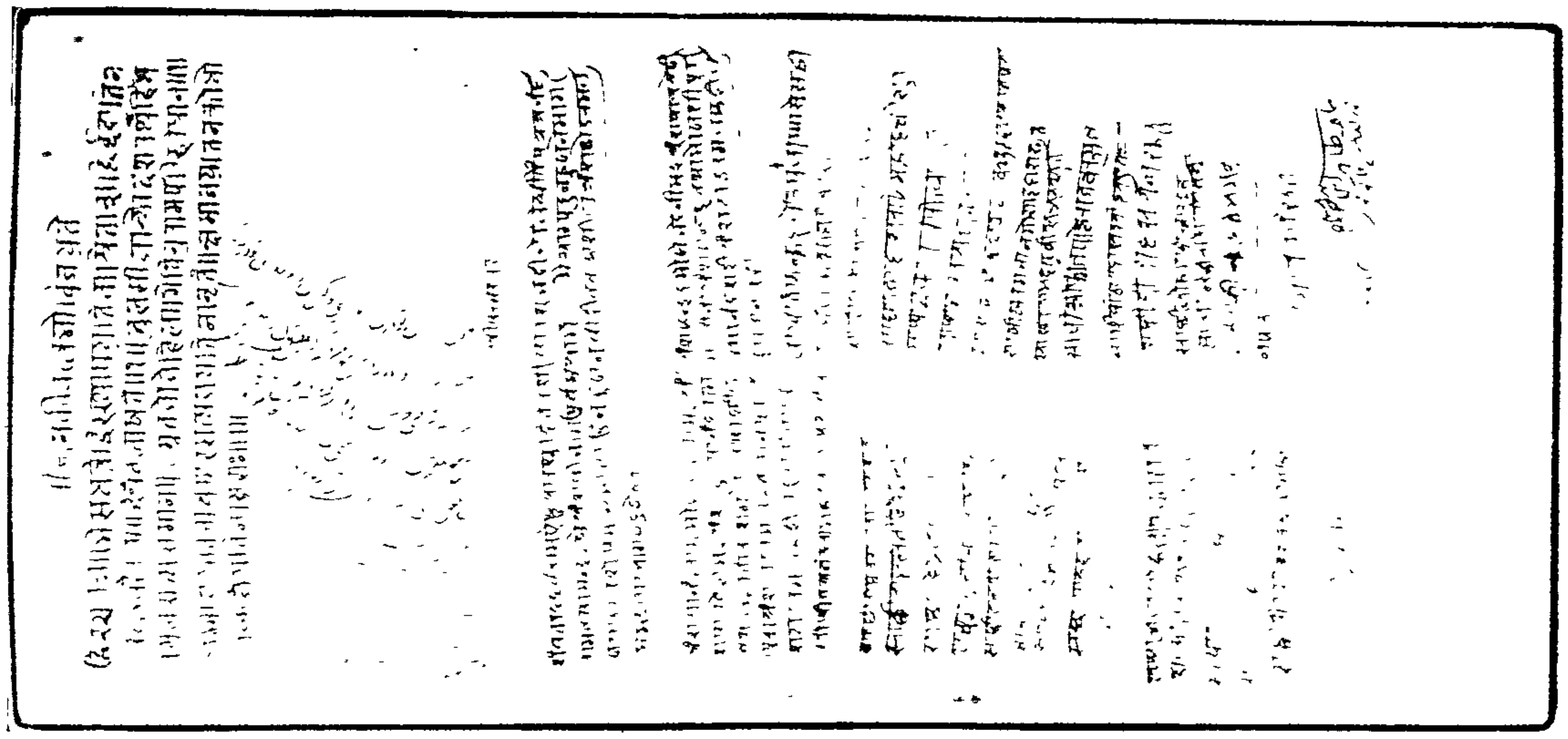
B



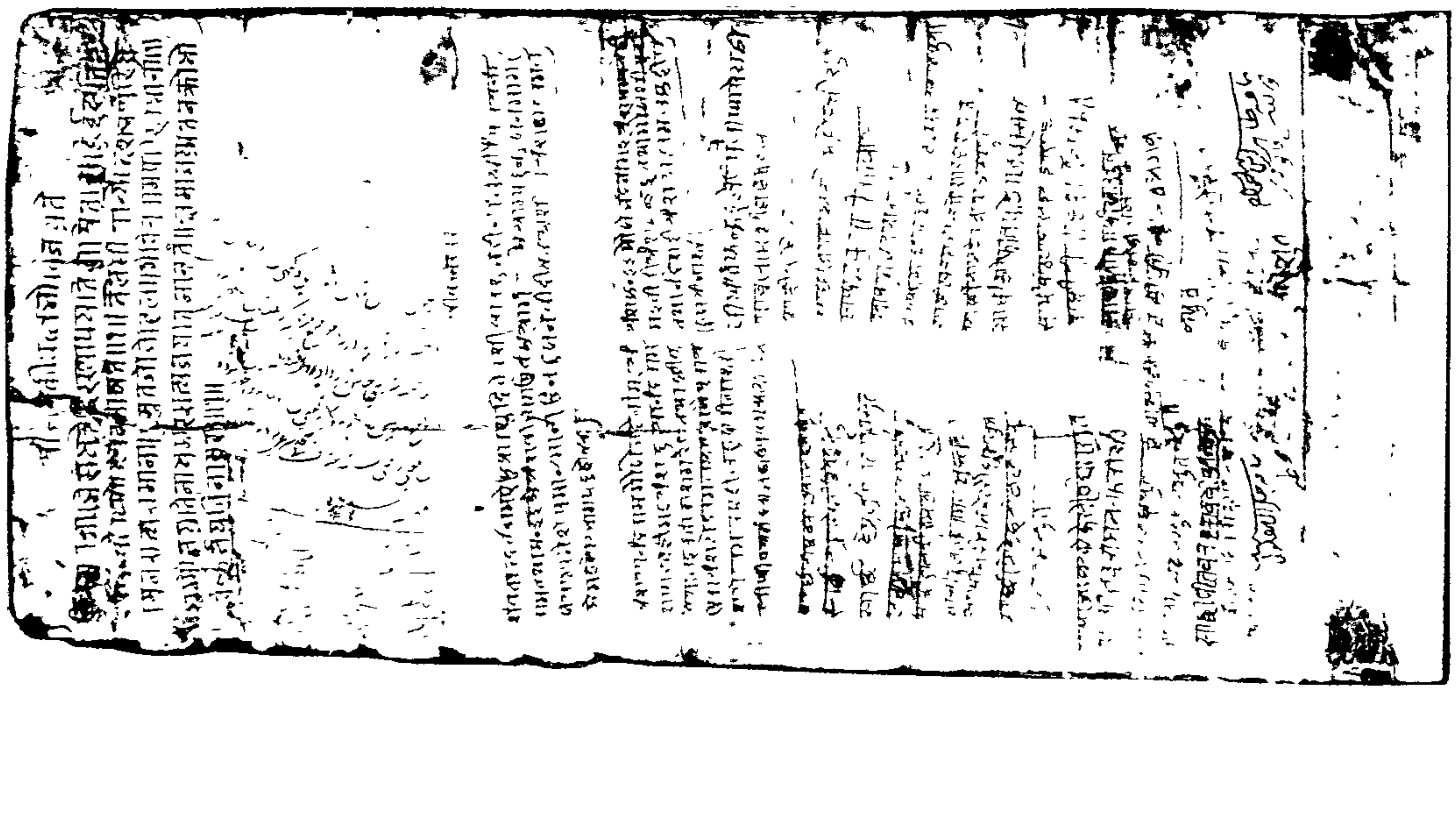
A

Block-print from Central Asia (size 12¼ in. × 11¼ in.): A, *before treatment*; B, *after treatment* (*see page 93*)

To face plate XXVII

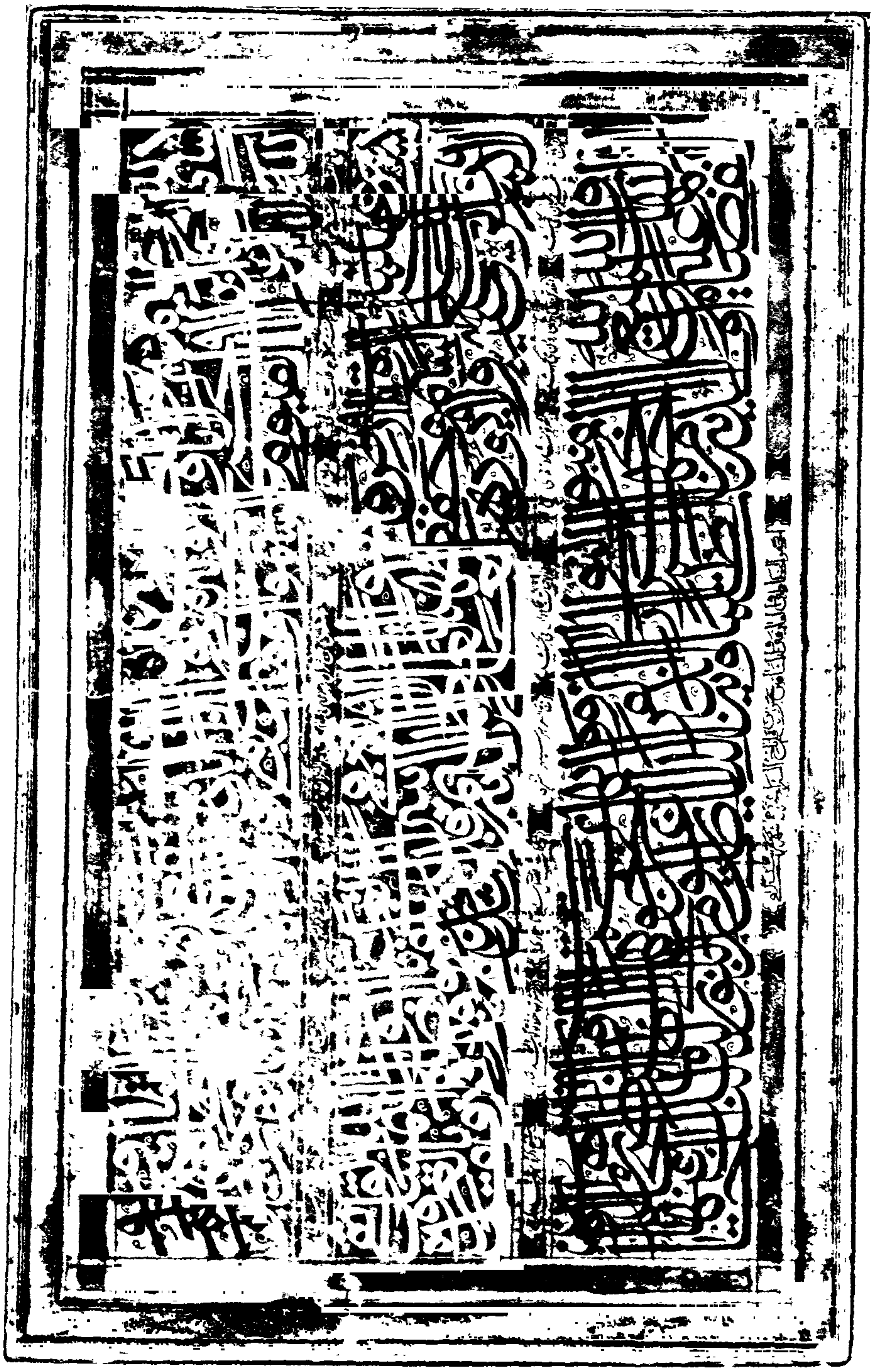


B



A

Manuscript of Sant Tulsi Dās: A, *before treatment;* B, *after treatment* (*see page* 95)



Varnished manuscript (*size* $14\frac{3}{4}$ *in.* $\times$ 9 *in.*): *the right one-third portion represents the cleaned part* (*see page* 96)

A

B

Modern oil-painting $(\frac{3}{4})$*:* A, *before treatment;* B, *after treatment* (*see page* 96)

B

Wall-painting from Central Asia (*size 7 in. × 7 in.*) : A, *before treatment;* B, *after treatment*
(*see page 97*)

Associate of the Grand Salon. It was 43 in. by 32 in. in dimensions and was done in oil on canvas. Flaking of the paint at several places was noticed very prominently. There could be several reasons for the deterioration of this painting, and violent movements which the canvas must have undergone in transportation from one place to another and the exposure to dust and dry and damp weather-conditions during storage must have contributed immensely to its deterioration.

The varied conditions of humidity and temperature are most detrimental not only to paint-films but to canvas-fibres. The expansion and contraction of the thick paint-layers are different from those of the cotton fibre, and as such the forces causing detachment of the paint-layer from the canvas must have been working all along. A lot of dust was found accumulated on the surface, which, at some places, seemed to be ingrained into the surface paint-layer. In a country like India, where temperature and humidity variations are very wide, the preservation of oil-paintings presents a very difficult problem. Paintings like the present one cannot survive long unless they are exhibited or stored in a place where humidity and temperature are controllable. Pl. XXVIII A shows the condition of the painting with the flaking parts marked as A, B, C and D. The paint-film had chipped off at some places and at others it had a tendency to flake off. Pieces were curling and they had stiffened to some extent due to oxidation.

The painting, therefore, required in the first instance the removal of dirt from the back side. The canvas was then removed from its stretcher and placed on a table. Dry brushing was done to remove the loose dirt from the painted surface, and then a wet sponge was applied throughout with a slight pressure so that the dampness did not reach the canvas. Dried oil has a slight or partial solubility in ethylene-di-chloride, alcohol, ethyl acetate etc. Mixtures of water and alcohol, ethyl acetate and toluene were therefore applied in this case to remove the ingrained dirt with restraint. When the solvents had dried a solution of 1 per cent methyl-metha-crylate in 80 per cent toluene and 20 per cent ethyl alcohol was injected from behind the canvas in the areas where the paint was showing signs of flaking. Immediately the flaking parts were pressed back to the canvas with a spatula. The portions thus treated were kept pressed between sheets of tissue-paper and glass for as long a time as was required for the volatilization of the organic solvents. It was not found necessary to apply preservative to the whole painting. The portions marked A, B, C and D on pl. XXVIII B show the condition of the treated portions. For the future preservation of such a painting it is necessary to avoid acute humidity and temperature deviations and to mount it on a proper stretcher in a frame protecting the back from dust, moisture and other impurities which are likely to get deposited on it.

5. A WALL-PAINTING

This fragment of a wall-painting was from Miran in Central Asia, belonging to the third-fourth century A.D. The plaster[1] consisted of a mixture of clay, straw and fibre, with a white coating to serve as priming. There was a uniform pink coloration on the surface, reported to be due to the presence of ferric oxide commonly known as red ochre. The designs were painted in red, black and grey. The layer of original mud-plaster was $\frac{1}{8}$ in. only in depth and was supported by a thicker layer of about $\frac{1}{2}$ in. of plaster of Paris.[2] The painting was not a fresco, because the pigments did not seem to be ingrained

[1] Aurel Stein, *Serindia*, III (Oxford, 1921), p. 1390.

[2] F. H. Andrews, *Catalogue of Wall Paintings from Ancient Shrines in Central Asia and Sistan* (Delhi, 1933), Introduction, p. xii.

into the plaster; further, the pigments, which would have remained unaffected in a fresco, easily came off in this case at the slightest touch and wetting.[1] On the surface there were dust, mud-accumulations and water-marks.

Treatment of wall-paintings other than frescoes is difficult since the scope for the use of solvents and chemicals is limited. Aqueous solutions are strictly prohibited, and recourse is, therefore, to be taken to organic solvents only. The adhesive originally present in the pigments in this case seemed to have decomposed, and this accounted for the pulverization of the pigments on the surface, though deterioration from soluble salts[2] was not noticeable. The problem, therefore, was to clean the surface of all extraneous material and fix back the pigments and the loose plaster to their positions.

The wall-fragment was, therefore, brushed with a fine Chinese brush so that only the superficially-accumulated dirt could be removed. Then a suitable mixture of alcohol with as few a drops of water as possible was prepared to remove the mud-accumulation and the water-marks, using toluene as a restrainer. Application of these chemicals was made through cotton-swabs to remove the mud in different stages, as it is not possible in the case of paintings on mud-plaster to work on damp areas for prolonged periods. The damp areas were then pressed back to their positions, and alcohol was applied on the whole panel so that it just gave a damp look to it temporarily. This treatment resulted in rendering the surface clean. Areas which had become more wet than was required were treated with a liberal quantity of alcohol. It required at least 24 hours for the painting to dry. Then a coating of ·5 per cent methyl-metha-crylate in 75 per cent toluene and 25 per cent methanol[3] was applied to the surface. This coating was allowed to dry, and the pigments which had not become fixed were further given one more coating of the preservative solution. Pl. XXIX shows the condition of the painting before and after treatment.

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[1] *Current Science*, VI, no. 5 (1937), pp. 223-25.
[2] *Ibid.*, IX, no. 10 (1940), p. 450.
[3] *Journal of Indian Museums*, IX (1953), p. 65.

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